The impact of a healthy eating intervention: A comparative, longitudinal observation of dietary intake, knowledge and behaviour in council sector nursery school children and their parents in Edinburgh.

Kirstie Lawton, BSc Hons

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In memory of Dr Isobel Davidson

Teacher, Mentor, Colleague, Friend

Abstract

Good nutrition is essential for optimal growth and functional development in children. Research indicates that the preschool years are essential for encouraging children to develop a taste for healthy food. Scotland's obesity rates are amongst the highest in the world, and in areas of low socio-economic status, obesity and related conditions are considered to be most prevalent. It is also widely reported that areas of deprivation are related to poor dietary intake. In 2004, Edinburgh Community Food Initiative (ECFI) was responsible for initiatives that were based on ECFI's 'provide and promote' philosophy, combining health promotion activities with the provision of fresh fruit and vegetables to schools, child and family centres and community centres in the most disadvantaged communities of Edinburgh. Funding was acquired from the Big Lottery Fund to initiate a citywide health initiative in the nursery school setting called 'the Pip Project'. The aim of this research was to identify dietary intake at baseline in pre-school children and their parents from council sector nurseries, and to observe changes in dietary intake and behaviour over a period of 20 months, comparing dietary intake of children and their parents from areas of lower socio-economic status who received the Pip project interventions to those from areas of higher socio-economic status, who did not. Dietary intake was recorded using a 5 day diet diary at three time points; prior to nursery school attendance (August 2005), at completion of year one (June 2006), and two months prior to leaving nursery (April 2007). A questionnaire was also completed to determine knowledge and dietary behaviour at baseline (August 2005) and at the end of the research period (April 2007). Baseline intake was compared to the National Diet and Nutrition Surveys for adults and for children aged 1.5 to 4.5 years, the Payne and Belton Edinburgh preschool dietary survey, the Food Standards Agency Low Income Diet and Nutrition Survey, and the standards devised by UK Scientific Advisory Committee for Nutrition (SACN). Results at baseline were comparable to results from other national surveys. Research indicated that all adults were aware of the 5 a day message and 80 % thought that 400 g was 'just right' or 'not enough'. Adults, and particularly those from the lower SES group, had clear knowledge of what constituted one portion of fruit or vegetables and did not report any barriers to healthy eating, however at baseline fruit and vegetable intake was 260 g/d, which was significantly lower ($p = < 0.05$) than the recommended 400 g/d and intakes were significantly less ($p = < 0.05$) in the lower SES group (219.5 g/d compared with 297.5 g/d in the higher SES group). Minimal increase was seen in fruit and vegetable intake of adults from the lower SES group, who consumed significantly less ($p = < 0.05$) than adults from the higher SES group by the end of the 20 month research period; children from the lower SES increased their intake by 1

portion (82 g) per day but still consumed less than the children from the higher SES group by stage 3 (203 g/d compared to 253 g/d). At baseline, the diet was balanced for adults and children in terms of % energy from CHO and fat, but mean intakes of both NME sugar and saturated fat were greater than the recommended maximum intake of 11 % total food energy. Mean intake NME sugar in children was 17.9 %; intakes were greater in the higher SES group (19.5 % compared to 16.6 %). Mean intakes were also significantly greater ($p = < 0.05$) in the parents from the higher SES group (15.2 % compared to 11 %). Mean intakes of NME sugar in parents decreased in both groups over the 18-month duration of the study but mean intakes in children remained high throughout the research period. Saturated fat intakes increased in adults from both SES groups, but were higher in the lower SES group at all stages. There was no change in mean saturated fat intake over time in children from the higher SES group, but mean intake decreased in children from the lower SES group (from 16.2 % to 14.1 %). Mean intake of NSP increased in both parents and children, but remained below the recommended 18 g/d throughout the study. With the exception of iron, mean intakes of all micronutrients for parents were greater than the RNI in both groups. Iron intake was lower than the RNI (14.8 mg/d) at all stages. At baseline intakes were lowest in the lower SES group (9.3 mg/d compared to 11.4 mg/d); 11 participants consumed less than the LRNI (8 mg/d), eight of whom from the lower SES group (73 % of participants). Mean intakes increased in the lower SES group by 3.7 mg/d over the duration of the study but neither group reached the RNI at any stage. At baseline, children met the RNI for all micronutrients, and there were no significant differences between groups. Overall the diet of children, particularly from the lower SES group, improved over the duration of the study, although salt and NME sugar intake did not decrease over time. Further research is required to investigate the best methods to improve diet in families with young children, with particular emphasis on reducing % energy from NME sugar and saturated fat, reducing salt intake and increasing fruit, vegetable and NSP intake.

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Abbreviations

ANOVA	Analysis of variance
AVFSM %	Average percentage of children who are entitled to free school meals (closest 3 schools to nursery)
BMI	Body Mass Index
Ca	Calcium
CEC	City of Edinburgh Council
COMA	Committee on Medical Aspects of Food Policy
DEP CAT	Deprivation Category by ward
DRV	Dietary Reference Values
EAR	Estimated Average Requirement
ECFI	Edinburgh Community Food Initiative
Fe	Iron
FSA	Food Standards Agency
FSM%	Percentage of children in the adjoining primary school who are entitled to free school meals
HSCIC	Health and Social Care Information Centre
IOTF	International Obesity Taskforce
IASO	International Association for the Study of Obesity
LIDNS	Low Income Diet and Nutrition Survey
LRNI	Lower Reference Nutrient Intake
MRC	Medical Research Council
NDNS	National Diet and Nutrition Survey
NME sugar	Non Milk Extrinsic sugar (added sugar)
NSP	Non Starch Polysaccharide
RNI	Reference Nutrient Intake
SACN	Scientific Advisory Committee on Nutrition
SES	Socio-Economic Status
SIMD	Scottish Index of Multiple Deprivation
Zn	Zinc

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Declaration

Except where assistance and advice has been duly acknowledged, the research described in this thesis has been entirely undertaken by myself, and the entire thesis composed by myself

Kirstie Lee Lawton, BSc Hons
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1 Introduction

Good nutrition is essential for optimal growth and functional development in children. Research indicates that the preschool years are key to encouraging children to develop a taste for healthy food, and there is evidence dating back 25 years (Birch et al, 1991) that given a variety of healthy foods and being allowed to eat what they wish, that young children will select a nutritionally balanced and healthy diet. However, current ‘fast food’ culture in Western society, combined with known barriers to healthy living means that children, and particularly those from low socio-economic areas, are consuming too much processed foods rich in fat, salt and sugar, and not enough micronutrient containing whole grain and fruit and vegetables (Nelson et al, 2007; Rustin et al, 2004; Gregory et al, 1995; Payne & Belton, 1992). The result is an increasing percentage of children and adolescents, and particularly those from areas of low socio-economic status, with a high prevalence of overweight and obesity (World Obesity, 2015). Dietary habits from childhood are then continued into adulthood with often devastating health effects.

1.1 Obesity and Health

World Obesity analysis (2010) estimated that globally, approximately one billion adults were overweight (Body Mass Index (BMI) 25 to 29.9) and a further 475 million were obese (BMI > 30) (World Obesity, 2015). In addition, it is estimated that up to 200 million school-aged children are overweight, with 40 to 50 million of those also classified as obese. In the European Union member states alone there are an estimated 260 million overweight and obese adults, and more than 12 million overweight or obese school aged children.

1.1.1 Current UK statistics (adults)

The prevalence of obesity has more than doubled in the UK in the last 25 years, with a marked increase in the proportion of adults that were obese between 1993 and 2012, from 13.2 % to 24.4 % among men and from 16.4 % to 25.1 % among women. In addition, the proportion of adults that were overweight including obese increased between 1993 and 2012 from 57.6 % to 66.6 % among men, and from 48.6 % to 57.2 % among women (Health and Social Care Information Centre (HSCIC), 2014). Statistically, Scotland has some of the biggest diet related health problems in the Western World. According to the 2010 data on international obesity rates from the National Obesity Observatory, Scotland had the 3rd highest prevalence of adult obesity at 27 %, below USA and Mexico (Bromley et al 2009). These findings are echoed by the World Obesity Federation, who observed an increase in obesity rates in Scotland from 20 % in 2000 to 26.5% in 2010. However, a slight decline was seen from 2010 to 2013 (World Obesity, 2014).

1.1.2 Current UK statistics (children)

Globally, Scotland also has the 4th highest prevalence of overweight and obesity in boys and the 5th highest prevalence in girls aged 2 to 15 years (Corbett et al, 2009). According to the Scottish Health Survey 2008, the rate of obesity in Scottish boys was 17 %, with 36 % classified as overweight or obese, and 13 % Scottish girls classified as obese, with 27 % classified as overweight or obese (Corbett et al, 2009). In addition 10.2 % of boys and 8.9 % of girls in aged 4-5 years in the UK were also classified as obese (National Obesity Observatory, 2008). In 2009, almost a third of children (29.7 %) were out with the healthy weight range (31.0 % of boys and 28.3 % of girls). For boys, prevalence increased between 1998 and 2008, followed by a sharp decline in 2009. For girls the corresponding figures were very similar each year and did not vary significantly. Findings by HSCIC support these findings; in 2012/13 the proportion of obese children in reception class and the proportion of children in year six was lower in 2011/12 than it had been in 2012/13 (9.3 % compared to 9.5 % and 18.9 % compared to 19.2 % respectively), although the proportion of children in year six was still greater than data from 2006/7 (17.5 %). The consequences of childhood obesity are very concerning for the future health of those children who are already overweight. Research from the Childhood Obesity National Support Team (2011) shows those children who are overweight or obese at age 4 to 5 years have a high risk of being obese at age 10 to11 years. Ispos MORI Social Research Institute, in conjunction with Hull PCT and the National Child Measurement Programme (NCMP), which was launched in 2005, found that 49 % of overweight boys at age 4 to 5 years and 54 % of overweight girls became obese by the age of 10 to 11 years, 68 % of obese boys and 75 % of obese girls at age 4 to 5 years remain obese by age 10 to 11 years, and only 14 % of obese boys and 13 % of obese girls achieved desirable weight by age 10 to 11 years. The same cohort of children was also followed up between the ages of 9 and 12 years. Researchers found there was little change in their weight status, supporting the view that overweight and obese children grow up to be overweight or obese adults (Ipsos MORI, 2010).

1.1.3 Financial impact of obesity

Direct medical costs for obesity include preventative, diagnostic and treatment related to obesity and associated co-morbidities. Other costs include income lost from decreased productivity, reduced opportunities, restricted activity, absenteeism, unemployment and premature death. In addition there are costs involved in producing equipment suitable for obese people in public places such as operating tables, reinforced beds etc. For example, in the USA estimates based on research by Finkelstein et al 2009 indicated that overweight and obesity cost $147 billion in 2008. An estimate of the financial cost of treating obesity and its consequent diseases in England was determined in the National Audit Office (NAO) report "Tackling Obesity in England" to be £480 million (based on 1998 costs). In 2002, The House of Commons Health Select Committee (HSC) estimated that the total cost of obesity and its consequences in England was around £3340–3724 million. In addition, when the costs of being overweight (BMI 25–29.9) were also taken into account, the HSC speculatively suggested that the total annual cost of obesity and overweight would be around £6.6–7.4 billion. Of this total, around £991–1124 million related to the direct healthcare costs of treating obesity and its consequences, comprising general practitioner consultations, in-patient and day case admissions, out-patient attendances and drug costs. This equated to 2.3–2.6 % of total net National Health Service (NHS) expenditure in 2001/02. The vast majority of this total was attributable to treating the consequences of obesity rather than treating obesity itself (McCormick et al, 2007).

In “The cost of doing nothing – the economics of Obesity in Scotland” (2003), Dr. Andrew Walker from the University of Glasgow Centre for Biostatistics estimated that the annual cost to the NHS in Scotland for managing and treating obesity and its consequences at £171 million (see table 1.1). His calculations determined that 2 % of this total was due to treating obesity itself and 98 % was due to the treatment of obesity co-morbidities. This estimate was based on a population obesity prevalence of 21 %. The current prevalence is 27 % (World Obesity, 2015).

Without intervention, the Foresight Report (Butland et al, 2007) estimated that by 2050, 60 % of men and 50 % of women could be clinically obese, and obesity related diseases would cost an extra £45.5 billion per year.

Table 1.1: Total cost to NHS Scotland of managing obesity and related diseases (2003)

Condition	Total cost for NHS
Obesity	£3,794,051
Hypertension	£57,364,649
Type 2 Diabetes	£28,036,392
Angina Pectoris	£36,776,558
Myocardial Infarction	£22,711,380
Osteoarthritis	£7,751,601
Stroke	£2,337,312
Gallstones	£3,440,793
Colon Cancer	£7,679,786
Ovarian Cancer	£286,107
Gout	£469,325
Prostate Cancer	£364,801
Endometrial Cancer	£319,729
Rectal Cancer	£144,380
TOTAL COST	**£171,476,865**

(Source: The cost of doing nothing – the economics of obesity in Scotland; Dr. Andrew Walker 2003).

1.1.4 The physical impact of obesity

According to the World Health Organization (2004) obesity is an important cause of morbidity, disability and premature death, by increasing the risk of a wide range of chronic medical conditions including diabetes, cardiovascular disease (angina, myocardial infarction (MI), ischaemic heart disease (IHD), stroke), hypertension and various cancers, gall bladder disease, fatty liver disease, sleep apnoea and osteoarthritis. The World Health Report 2002 estimated that more than 2.5 million deaths annually are weight-related and forecast this could rise to 5 million by 2020. In 2006, deaths directly related to obesity have been estimated at 320,000 a year in Europe and more than 300,000 in the US (Kosti & Panagiotakos, 2006).

World Obesity recently suggested that even modest weight gain has a powerful impact on the risks for those who are genetically and physiologically vulnerable to type II diabetes, with around 90 % of type II diabetes attributable to excess weight (World Obesity, 2014). The World Health Organization (2012) estimates that more than 194 million people are affected by diabetes worldwide, rates of which have increased by 50 % in the last decade. It is predicted that the number of people with diabetes will increase by 150 % in the next 25 years (World Health Organisation (WHO) World Health Report, 2002).

1.1.5 Social impact of obesity

According to the International Association for the Study of Obesity (IASO), the stigma associated with obesity can lead to psychological problems including vulnerability to depression, low self-esteem, poor body image, maladaptive eating behaviour and exercise avoidance (National Obesity Observatory, 2001). Findings by Franklin et al (2006) demonstrated a direct link between increased weight and low self-worth, with obese girls particularly being five times less likely to have a high self-worth than their normal weight counterparts.

A study by Richardson et al in 1961 clearly demonstrated a stigma related to obesity in childhood. In 2003 this study was repeated, with findings demonstrating that obese children were liked less than children of a normal weight for age (Latner and Stunkard, 2003). A study by Arshad and Hill in 2010 which surveyed 332 children in UK primary schools found that children perceived overweight children as having fewer friends, less liked by their parents, less fit, less healthy, ate a poor diet and were less likely to achieve at school. According to a study by Musher-Eizenman et al, (2004) children as young as four consider fat children to be less nice, and be a less likely choice for a friend.

Overweight and obesity can also directly affect academic achievement. Studies also show that obese children are less likely to achieve well in school, are half as likely to enter higher education as their normal weight counterparts (Karnehed et al, 2006) and if they do enter university, are less likely to complete their degree (Fowler-Brown et al 2010).

1.1.6 The link between obesity and family

The role of the family is key to confronting the obesity epidemic and to making healthy lifestyle changes. Statistics from the National Centre for Social Research (2012) indicate that a child is more likely to be overweight if their parents are overweight, with only 3% of children who are obese who do not have parents who are obese or overweight (Childhood Obesity National Support Team, 2011). Findings by Jotangia et al (2005) indicate that for both boys and girls, a greater number of children who lived in households where both parents where classed as obese or overweight were themselves obese (19.8 %) compared with children who lived in households where one of the two parents was obese (8.4 %) or in households where neither parent was overweight or obese (6.7 %).

1.2 Poverty and Health in Scotland

Poverty is an extremely emotive issue, and one not usually associated with westernised countries. Although the UK is considered an affluent, developed country, the effects of living in a deprived area, including low standard housing, poor diet, higher crime rate, high prevalence of drugs, higher prevalence of anti-social behaviour, lower level of education and lower average income can have a devastating impact on the health and wellbeing of a significant proportion of the population. Material wealth and the area where a person lives can have a massive influence on their health, reflected in high levels of preventable chronic disease and lower life expectancy in areas of low socio-economic status in the United Kingdom (James et al, 1997).

1.2.1 Defining poverty

When discussing poverty and health it is essential to first understand the various definitions currently applied to the idea of poverty:

Absolute poverty is based on defining a fixed cut off point indicating a level of basic human needs and human rights. In terms of the United Nations Millennium Development Goals, the definition for 'Absolute Poverty' is defined as less than $1.25 per day (http://www.un.org/millenniumgoals/poverty). Levels of inequality can increase even while the number of people living in absolute poverty decreases (Maxwell, 1999).

Relative poverty is a comparative measure that quantifies a level of inequality within a defined population. Levels of relative poverty can be decreased as a society becomes more equal (Maxwell, 1999).

Multiple Deprivation recognises that a number of quantifiable factors combine to inhibit the wellbeing and development of people and population groups (www.scotland.gov.uk, 2011).

Social exclusion is not a definition of poverty, but an indication of an effect of poverty. It shows how individuals and groups are restricted from benefiting from and participating fully in opportunities available to the general population. It results from a combination of problems associated with poverty and social deprivation (Scottish Government, 2011)

While in present day Scotland nobody experiences the absolute poverty afflicting some developing nations, relative poverty and the resultant health inequalities are still very much a feature of the social landscape. Social inequality, which is the difference between those who are doing averagely well and those who are disadvantaged, continues to exist in Scotland. To understand food related poverty it is first essential to understand the disadvantages that people from areas of low socio-economic status face.

The Scottish Index of Multiple Deprivation (SIMD) is the Scottish Government's official tool for identifying small area concentrations of multiple-deprivation across Scotland, and takes the approach that deprivation is multi-dimensional. It uses data covering income, health, employment, housing, crime, access to services, education and geography to produce a picture of how and where communities are affected by deprivation, identified as 'the range of resources that arise due to lack of resources or opportunities that are not only linked to finances' (Scottish Government, 2009).

Scotland is divided into 'data zones'. Data zones, previously known as 'wards', are a statistical geography that were developed in 2004 and have maintained the same geographical boundaries since. They are population based with an average of 750 people living in each one. Because they are population based, data zones can vary hugely in size. Data gathered from these data zones has been used to determine which areas of Scotland are the most socially disadvantaged. The following sections highlight some of the key findings from both the Scottish Index of Multiple Deprivation (SIMD) reports (2004, 2006 and 2009) and the 2009 Scottish Household Survey:

1.2.2 Movement in socio-economic status

A person who lives in an area considered as deprived is more likely to remain in that area for the duration of their life than a person from more affluent classes. In addition, areas that are considered as multiply deprived are unlikely to move up in socio-economic status within a short time frame; 81 % of the data zones identified by the SIMD 2009 report as being in the 15 % most multiply deprived were also identified in the same category on both the SIMD 2006 and the SIMD 2004 reports (776 out of 862 data zones remaining in the same category over a five year period). In addition, the majority of data zones in the 5 % most deprived category in the SIMD 2009 report have been in the 5 % most deprived category on all 3 reports.

1.2.3 Urban living and inequality

According to the SIMD 2009 report, of the data zones in the 15 % most deprived in Scotland, around 92 % are in urban areas compared to 2 % in rural areas. The proportion of employment-deprived individuals is also highest in large urban areas with just under 50 % of unemployed individuals in Scotland living in urban areas of deprivation, a proportion that falls to 5 % in rural areas. As with employment deprivation, the proportion of income deprived people living within the 15 % most deprived in each category of the urban rural classification is highest in large urban areas at 50 % and lowest in rural areas at 5% (Scottish Index of Multiple Deprivation, 2009).

In addition to employment and income, data shows that those living in rural rather than urban areas consider themselves to have a better overall quality of life. Data from the Scottish Household Survey (2009) comparing rural and urban opinion showed that only 17 % of those in remote rural areas dislike the unpleasant environment they live within, compared to 38 % in large urban areas. Research also indicated that prevalence of neighbourhood problems were, in almost all cases, more likely to be perceived to be common by people living in urban areas as compared to those from rural areas. Perceptions of antisocial behaviour range between 16 % and 20 % in urban areas, compared with 5 % in remote rural areas. A similar pattern is seen in perceptions of vandalism, graffiti or damage to property ranging from 18% in large urban areas to 4 % in remote rural areas (Scottish Household Survey, 2009). The proportion and share of data zones in the 15 % of areas that are most deprived in relation to crime are also highest in large urban areas (51 %) and urban areas as a whole (84 %). With this data there is a clear urban rural split in the distribution, with low proportions of crime in the 15 % most deprived areas in rural areas (3 % in accessible and remote rural areas).

1.2.4 Antisocial behaviour and low socio-economic status

As areas become more deprived, antisocial issues become more widely reported. According to the 2009 SIMD report, the difference in prevalence of antisocial behaviour between the most and least deprived areas of Scotland is considerable, for example drug misuse and dealing (32 % compared to 2 %) and vandalism (35 % compared to 8 %). There is also evidence of those living in the most deprived areas of Scotland feeling less sure about being safe in their home alone at night (6 % feel a bit or very unsafe, compared to 2 % from the rest of Scotland). Overall ratings of neighbourhood have differed drastically between those living in the 10 % most deprived areas, with only 23 %

rating their neighbourhood as a very good place to live, compared to those living in the rest of Scotland, with over 90 % typically saying their neighbourhood is a fairly or very good place to live. Furthermore, 77 % of those living in the 10 % least deprived areas rate their neighbourhood as a very good place to live (Scottish Household Survey, 2009). People living in the 15 % most deprived areas in Scotland are less likely than those living elsewhere to consider their local neighbourhood as pleasant, safe, having a sense of community or people being friendly. Similarly, 13 % of people in the most deprived areas say they like nothing about their neighbourhood compared with just 3 % in the rest of Scotland. Finally, 42 % of people in the 15 % most deprived of areas felt that their neighbourhood had no sense of community, or stated problems with residents and substance abuse compared with 16 % of those in the rest of Scotland (Scottish Household Survey, 2009).

1.2.5 Employment, academic achievement and low socio-economic status

According to SIMD (2009) employment data, 12 % of the working age population of Scotland is employment deprived. Relating this data to areas of low socio-economic status, there are currently 459,495 working age people who live in the 15 % most deprived data zones, and of these, 121,725 (26 %) are employment deprived. According to the Scottish Household Survey (2009), Scottish people who had attained degree level or professional qualifications had the highest level of full-time employment (59 %). Of those who have no qualifications, just under a third (32 %) was in full-time employment. Similarly, 18 % of those with no qualifications were permanently sick or disabled, higher than any other groups (Scottish Index of Multiple Deprivation, 2009).

1.2.6 Income and low socio-economic status

According to the Scottish Index of Multiple Deprivation (SIMD) 2009 general report, 36 % of people living in the 15 % most income deprived areas of Scotland are income deprived. This compares to 12 % deprivation in the rest of Scotland.

1.2.7 General health and low socio-economic status

The association between social class, morbidity and mortality is well established. It has long been recognised that experience of living in low-income circumstances will significantly increase chances of suffering and dying from diet-related diseases such as cancer, stroke and coronary heart disease (James et al 1997). People living in the 15 %

most deprived of areas in Scotland are around twice as likely to say their health is poor compared with those living elsewhere (12 %, compared with 6 %). Over 70 % of the data zones listed in the 15 % most deprived in terms of health in the 2009 SIDM report have been in this category since the initial report in 2004 (Scottish Index of Multiple Deprivation, 2009).

1.2.8 The association between obesity, co-morbidities and socio-economic status

Children and adults are more likely to be overweight and obese if they are from a low socio-economic background. It was suggested in 2008 by Zaninotto et al that if recent trends in adult obesity continued, approximately third of all adults in the United Kingdom (almost 13 million individuals) would have been classified as obese by 2012 and of these, around 34 % would have been from manual social class, compared to 29 % of adults from all other social classes. Although obesity rates did not incline to this level, there is still a higher rate of obesity in families from lower socio-economic status than those from other social classes. The rate of increase in families of low socio-economic status has also been greater than in more affluent families. Between 1995 and 2003, obesity prevalence rose by 5 % for those in manual households and rose by 3 % for those in non-manual households. Increases in overweight (including obesity) followed the same pattern, increasing by 7 % for those in manual households and 5 % for those in non-manual households between 1995 and 2003 (Jotangia et al 2005; Zaninotto et al 2008).

Table 1.2 demonstrates how rates of obesity and obesity related conditions increase by social class, where (I) represent the highest social class and (V) represents the lowest social class. This data, compiled by James et al in 1997 shows that prevalence of obesity and all related conditions is lowest in the highest socio-economic group and becomes progressively higher the further down the class scale (with the exception of cholesterol in men). The difference in prevalence is most notable in the female population.

A study by Jotangia et al (2005) found that there was a clear association between the prevalence of obesity among children and area deprivation. Levels of obesity increased from 11.2% for those least deprived to 16.4% for those most deprived. The prevalence of obesity tended to increase as area deprivation increased.

Table 1. 2: Observed prevalence of disease and risk factors for disease within social class, in men and women of all ages (values are percentage of population; blood pressure is the mean blood pressure by social class)[1]

Social class

	I	II	IIINM	IIIM	IV	V
Men						
Ischaemic heart disease	5.1	5.4	6.0	7.7	7.0	6.4
Stroke	1.3	1.6	1.7	2.3	2.7	2.1
Mean blood pressure (mm Hg)	136/76	137/77	138/76	139/77	138/77	139/77
Cholesterol > 6.5 mmol/l	26	28	27	27	27	26
Obesity (body mass index >30)	9.9	13.5	13.7	15	15	14
Women						
Ischaemic heart disease	1.8	3.4	5.2	4.4	5.9	7.2
Stroke	0.5	0.9	2.3	1.5	2.0	2.5
Mean blood pressure (mm Hg)	130/72	132/72	136/73	134/73	136/73	141/75
Cholesterol > 6.5 mmol/l	26	29	35	33	33	36
Obesity (body mass index >30)	11.8	14.3	15	19.7	21.9	22.6

Source: James et al, 1997

There was also a relationship between childhood obesity prevalence and household income. In particular, childhood obesity rates increased from 13.3 % and 12.5 % in the two highest income quintiles to 16.3 % and 15.8 % in children from the two lowest income quintiles. Levels of childhood obesity were lowest among managerial or professional households (12.4 %) and highest among semi-routine and routine households (17.1 %).

The prevalence of obesity was highest among children from inner city areas than from all other area types. Around one in five children from inner city areas were obese whereas less than one in six children from the other types of area was obese (Jotangia et al, 2005).

1.2.9 The association between other dietary factors and socio-economic status

Although obesity and the related co-morbidities are the biggest diet related public health concern, there are many other diet related diseases and medical conditions more prevalent in low socio-economic groups than in more affluent classes. These include premature delivery and low birth weight, anaemia, lung, stomach, colon and other cancers, diverticulitis, constipation and other bowel conditions, cataracts and bone diseases such as osteoporosis (James et al 1997).

[1] I = Professional Occupations; II = Managerial and technical occupations; IIIN = Skilled non-manual occupations; IIIM = Skilled manual occupations; IV = Partly skilled occupations; V = Unskilled occupations (1990 standard occupational classification, London HMSO 1991)

Iron deficiency is prevalent in the United Kingdom, and particularly in children from areas of low socio-economic status, with one in six children below the age of 18 months and one in eight children between 18 months and 4 ½ years having low blood haemoglobin levels (Gregory et al, 1995). There is also a growing prevalence of obese children showing micronutrient malnutrition that may be related to consuming a high-energy low nutrient diet (Pena and Bacallao, 2000; Pinhas-Hamiel et al, 2003). According to the 1995 National Diet and Nutrition Survey (NDNS), dental disease in children is inversely correlated to social class, with 68 % of children from areas of low socio-economic status having one or more tooth decayed, missing or filled compared with 32 % of children from affluent areas (Gregory et al, 1995). Association between dental caries in early childhood and socio-economic status has been well documented, and is more commonly found in children who live in poor economic conditions, who are born to single mothers, and whose parents have low educational level, especially those of illiterate mothers (Colak et al, 2013). A report published by the Royal College of Surgeons Faculty of Dental surgery (2015) states that almost a third of five-year-olds in England are still suffering from tooth decay and the average child with decay has at least three teeth affected, with highest prevalence in areas of low socio-economic status (Royal College of Surgeons, 2015).

1.3 Diet related health statistics in Scotland

It is highly considered that in western culture, and especially in the diet of people from low socio-economic areas, there is over consumption of high fat, high sugar, high salt processed foods and minimal consumption of fruits, vegetables and whole grains. Overconsumption of high fat foods and of food in general leads to obesity and the associated co-morbidities such as diabetes, fatty liver disease, coronary heart disease and cardiovascular conditions such as hypertension, atherosclerosis, hyperlipidaemia and raised blood cholesterol, while low consumption of foods rich in essential nutrients can lead to a wide range of health issues including poor bone health, anaemia and cancer (World Health Organisation, 1990).

1.3.1 Obesity related diseases

According to the NHS Scotland Information and Statistics Division 2013 data, obese women are 13 times more likely to develop type II diabetes, four times more likely to suffer high blood pressure, 3 times more likely to develop cancer of the colon and 30 %

more likely to suffer a stroke than women within the healthy weight range. Obese men are five times more likely to develop type II diabetes and about twice as likely to develop osteoarthritis. Figures released in 2003 by the Scottish Public Health Observatory, 500,000 cases of high blood pressure, 50,000 cases of coronary heart disease and 900 of cases of cancer, mostly of the colon, were caused by obesity in Scotland.

Table 1.3 shows the estimated prevalence of different types of disease in the Scottish adult population and the number of Scots affected from data collected prior to, and compiled in, 2003. The third column of data shows an estimate from the National Audit Office report of the proportion of each disease that can be attributed to obesity. The final column then shows how many Scots have a disease as a result of obesity (Walker, 2003). Given that rates of obesity have since increased to 27 %, it is assumed that these figures will also increase accordingly.

Table 1.3: The prevalence of obesity and related diseases, and the number of people who are ill as a result of obesity (2003 data)

Condition	Prevalence rate	People	Obesity-related	People
Obesity	20.85%	853,599	100%	853,599
Hypertension	16.50%	675,510	36%	243,184
Type 2 Diabetes	2.40%	98,256	47%	46,180
Angina Pectoris	4.60%	188,324	15%	28,249
Myocardial Infarction	2.75%	112,585	18%	20,265
Osteoarthritis	4.06%	166,048	12%	19,926
Stroke	1.25%	51,175	6%	3,071
Gallstones	0.14%	5,721	15%	858
Colon Cancer	0.05%	2,207	29%	640
Ovarian Cancer	0.01%	590	13%	77
Gout	0.51%	21,025	47%	9,882
Prostate Cancer	0.04%	1,838	3%	55
Endometrial Cancer	0.01%	610	14%	85
Rectal Cancer	0.03%	1,150	1%	12

(Source: The cost of doing nothing – the economics of obesity in Scotland; Dr. Andrew Walker 2003)

Figures from the National Audit Office (2003) showed that heavily overweight people are 18 % more likely to need hospital treatment than those of normal weight in Scotland. According to the NHS Scotland statistics, obesity is a disease with important cost consequences that rank it second only to smoking as a cause of burden upon the health service (ISD Scotland, 2011).

1.3.2 Diabetes

Diabetes results from reduced production of the hormone insulin, resistance of body tissues to the effect of insulin, or both. The result is abnormally high levels of glucose (sugar) in the blood and widespread disturbances to metabolism. Type I diabetes is more common among younger people and usually needs treatment with insulin; Type II diabetes is the most common form (around 90% of cases worldwide) and is more common among older people and those who are overweight. Diabetes increases the risk of coronary heart disease, stroke, renal (kidney) failure, peripheral vascular disease, neuropathy (damage to nerves) and visual problems, including blindness. The number of cases of type II diabetes is increasing rapidly in the UK and worldwide, most likely because of increasing levels of obesity and ageing populations. In the UK, where diabetes is a leading cause of blindness, renal failure and neuropathy, there are 2.2 million people with diagnosed diabetes. The most recent Scottish Diabetes Survey (2009) estimates that there were 228,004 people with a diagnosis of diabetes in Scotland at the start of 2010, a crude prevalence of 4.4% (see table 1.4). NHS Scotland also estimates that more than 20,000 people in Scotland are undiagnosed. Life expectancy is reduced on average by 20 years in those with Type I diabetes and up to 10 years in Type II diabetes.

The majority of registered diabetic patients (87.4 %) in Scotland have type II diabetes, which in 2010 equated to 199,264 people. Furthermore, prevalence is increasing rapidly (Diabetes in Scotland, 2015). Part of this increase is likely to be due to increased levels of awareness of diabetes among health professionals and the public and more complete recording of diagnoses of diabetes as a result of improved information systems. However, the other reason for the increase is likely to be due to poor diet (specifically excess energy intake), low levels of physical activity and the resulting increase in levels of obesity. Type II diabetes is strongly associated with ethnicity, social deprivation and age, with prevalence higher in areas of low socio-economic status (National Diabetes Audit Executive Summary 2008 – 2009), and the effect of deprivation on the prevalence of Type 2 diabetes is most pronounced in the young and young middle aged. More men than women have diagnosed diabetes; 56.1 % compared with 43.9 % in those with type I diabetes and 54.6 % compared with 45.4 % in those with type II diabetes. Type II diabetes is also more common in the families of those with Type II diabetes, and a number of genetic markers of increased risk have been identified (Scottish Diabetes Survey, 2009).

Table 1.4: Number of patients included in Scottish Diabetes Surveys 2001-2009

Survey	Number on diabetes register	Crude prevalence	Relative change from previous year, number and per cent	
2009	228,004	4.40 %	8,041	3.70%
2008	219,963	4.30 %	10,257	4.90%
2007	209,706	4.10 %	12,905	6.60%
2006	196,801	3.90 %	24,014	13.90%
2005	172,787	3.40 %	10,841	6.70%
2004	161,946	3.20 %	27,982	20.90%
2003	133,964	2.60 %	30,129	29.00%
2002	103,835	2.00 %	-1,942	-1.80%

Source: Scottish Diabetes Survey, 2009

Overweight is an important risk factor: the risk of Type II diabetes is around ten times higher among those with a Body Mass Index (BMI) over 30 compared with those with a BMI under 30. Waist circumference has been also proposed as a measure of central obesity, which is linked with the risk of type II diabetes. In Scotland, Body Mass Index (BMI) was recorded for 89.7 % of patients with Type II diabetes between 2008 and 2009. Of these patients, 32.7 % were overweight (BMI 25-29.9kg/m^2) and 51.0 % are obese (BMI 30kg/m^2 or over). However, despite type II diabetes being more prevalent in obese patients, 12.7 % also had a normal weight (BMI 18.5-24.9kg/m^2) (Scottish Diabetes Survey, 2009).

Diabetes was the cause of 6,687 hospital admissions in Scotland in 2008, and was the underlying cause of 730 deaths in Scotland in 2008 and contributed to a total of 4,052 deaths (Scottish Public Health Observatory, 2011). In addition, diabetes is under-recorded in hospital discharge records and in death certificates; these figures are therefore likely to considerably under-estimate the true number of admissions and deaths (ISD Scotland, 2011). In 2003, it was estimated that diabetes Type II cost NHS Scotland £28,036,392 (Walker, 2003). Diabetes is clearly linked with cardiovascular disease (CVD). According to the 2009 Scottish Diabetes Survey, 21,471 (9.5 %) of registered diabetes patients have a record of a previous myocardial infarction. 11,575 (5.1 %) people with diabetes are recorded as having had a cerebrovascular accident (stroke), an increase in numbers but a similar percentage to that in previous surveys.

1.3.3 Cardiovascular disease

Cardiovascular disease (CVD) is a term that brackets a number of medical conditions effecting the heart and system of blood flow in the body, such as coronary heart disease (CHD), and cerebrovascular diseases such as stroke. Coronary heart disease and cerebrovascular disease are linked to the medical condition atherosclerosis, which is a disease in which plaque, made up of fat, cholesterol and calcium, forms in the arteries. Atherosclerosis is a leading cause of coronary heart disease, angina and stroke (National Heart, Lung and Blood Institute, 2016a). The causes of atherosclerosis are not known, although include lack of physical activity, and an unhealthy diet are risk factors. Atherosclerosis is clearly linked with diet, and is particularly linked with consumption of fat, which increases the blood triglyceride and cholesterol levels. Obesity is also a risk factor for cardiovascular disease.

Prevalence of cardiovascular disease (CVD) in Scotland is similar in men (15.2 %) and women (13.7 %) aged 16 and over, and of those, 9.4 % of men and 6.7 % of women had coronary heart disease or stroke (Scottish Health Survey, 2009). Prevalence is also greater in areas of lower socio-economic status. The Food Standards Agency Low Income Diet and Nutrition Survey (Nelson et al, 2007) found that 61 % of men and 65 % of women had raised cholesterol at levels linked with a higher risk of cardiovascular disease.

The number of prescriptions for cardiovascular disease (both coronary heart disease and cerebrovascular disease) increased by 61 % in the last decade, from 15 million in 2000/01 to 25 million in 2009/10. The associated costs over the same period rose by one fifth, from £150 million to £187 million (ISD Scotland, 2011).

1.3.4 Coronary heart disease

Coronary heart disease (CHD) is a preventable disease that kills around 8,000 people in

Scotland every year. The disease is caused when the heart's blood vessels, the coronary arteries, become narrowed or clogged and cannot supply enough blood to the heart (atherosclerosis). This can cause a heart attack (myocardial infarction), chest pain or angina. Almost 40,000 people in Scotland suffer from angina, and 11,000 people suffer from heart attacks each year (ISD Scotland, 2011).

Prevalence of the associated risk factors such as smoking, poor diet and physical inactivity is high. Around 7 % of men and 5 % of women are living with CHD (Corbett et al, 2010). Heart disease is the second most common cause of death in Scotland and death rates are amongst the highest in Western Europe. In Scotland, almost a fifth of deaths are directly related to heart disease and the majority of those from CHD. Physically inactive people have double the risk of CHD and incidence is highest amongst people who are obese.

Table 1.5: Table to show the relationship between social class and rate of CHD

		All Ages			**Ages under 65**		
SIMD Decile		Total Deaths	Crude Rate per 100,000 Population	SMR*	Total Deaths	Crude Rate per 100,000 Population	SMR
Most Deprived	**1**	5746	1066.8	129.6	1409	308.9	190.8
	2	5665	1077.9	117.4	1153	263.8	153.0
	3	5731	1103.1	112.7	1003	234.6	133.5
	4	5378	1046.3	106.5	867	204.5	113.3
	5	4863	969.6	102.2	785	188.1	103.0
	6	4507	910.4	95.4	640	154.8	82.7
	7	4150	854.3	91.8	537	131.5	69.7
	8	3669	765.0	85.5	461	113.0	62.7
	9	3194	645.9	81.2	407	95.0	53.6
Least Deprived	**10**	2948	580.5	69.7	310	71.0	40.7

Source: www.isdscotland.org/isd/5888.html (accessed March 2011)
SMR: Standard Mortality Rate

Mortality rates have significantly reduced over the last 10 years; the overall age sex standardized rate for CHD mortality fell from 177.9 per 100,000 (population) in 2000 to 103.7 per 100,000 in 2009, a reduction of almost 42 %. In Scotland, the targets (revised in 2004) included a 60 % reduction in CHD mortality and a 50 % reduction in stroke mortality in the under 75s between 1995 and 2010. Latest statistics show that this target was almost achieved with a 59.6 % reduction over the period 1995 to 2009. However, this was mostly due to the development of drug therapy such as statins. In the year ending March 2010 spending on statins was around £70 million (ISD Scotland, 2011). CHD has associations with social inequality. Mortality rates from CHD in the most deprived areas in Scotland are almost double those in the least deprived areas (see table 1.5). For premature deaths, the inequality gap is even greater (ISD Scotland, 2011).

1.3.5 Hypertension (high blood pressure)

Hypertension is a term that is used to describe high blood pressure. Blood pressure is a measurement of the force against the walls of the arteries as the blood is pumped around the body. Many factors can affect blood pressure, including the amount of water and sodium in the body, the condition of the kidneys and blood vessels, and the levels of various hormones in the body (Beevers et al 2001). High blood pressure increases the risk of stroke, MI, heart failure and kidney disease (National Heart, Lung and Blood Institute, 2016b).

Although sodium is critical for the function of nerves and muscles including the heart muscle, too much may lead to high blood pressure. Sodium occurs naturally in most foods and in drinking water. However, high levels of sodium are added to processed and canned foods. Fast food is also generally high in sodium (Litchenstein et al, 2006). Because of the dangers of hypertension and the link between salt intake and hypertension in those who are salt sensitive, the Scottish Government has clear guidance on recommended salt consumption of no more than 6 grams per day. Around a third of adults (34.6 % of men and 30.2 % of women) had high blood pressure (hypertension) in 2008/2009.

1.3.6 Cancer

As of 31 December 2009, there were approximately 153,000 people in Scotland who were living with cancer that had been diagnosed within the previous 20 years (ISD Scotland, 2011). In that year, 14,300 males and 15,300 females were diagnosed with a type of cancer (other than non-melanoma skin cancer). The most common type of cancer diagnosed in Scotland is lung cancer, followed by breast, colorectal and prostate. Breast cancer is the most common cancer in women, and prostate and lung cancer are the most common in men. In 1995, Sharp et al found that in Scotland, mortality from all cancers was higher in lower socio-economic groups, even though breast cancer and bowel cancer are more prevalent in higher socio-economic groups. Factors other than diet affecting risk were smoking, consumption of alcohol, and a lack of exercise (Sharp et al, 1995).

Most cancers are affected to some degree by dietary intake. Obesity increases risk of breast, ovarian and cervical cancer in women. A high fat diet combined with reduced wholegrain, fruit and vegetable consumption is linked to cancers such as colon, gastric and breast cancer (Key et al, 2004, Lanou & Svenson, 2010) although further research is required. Furthermore, there are many antioxidant rich foods that are considered beneficial in both the prevention and cure of a wide range of cancers (Valko et al (2006); Steinmetz & Potter (1996); Gandini et al (2000); Vecchia et al (2001)). Further discussion on the diet and the prevention of disease can be found in section 1.7.

Table 1.6: Table to show Scotland age-standardised incidence and mortality rates (EASRs), by SIMD 2006 deprivation quintile for all malignant neoplasms excluding non-melanoma skin cancer

	Incidence		Mortality	
SIMD 2006 Deprivation Quintile	Number of registrations	EASR	Number of death registrations	EASR
1 (least deprived)	24,215	378.9	11,374	165.9
2	26,454	384.2	13,497	182.3
3	28,555	410.2	15,306	204.7
4	30,451	450.9	17,313	237.8
5 (Most deprived)	30,073	495.0	17,822	278.7
Test for trend (Poisson regression)		<0.001		<0.001

EASR: age-standardised incidence rate per 100,000 person-years at risk (European standard population)
Sources: Scottish Cancer Registry, ISD (incidence); General Register Office for Scotland (GROS) (mortality and populations) Incidence: combined period 2004-2008; mortality: 2005-2009 Data extracted: Sept 2010

1.4 Barriers to healthy eating (adults)

A number of obstacles to maintaining healthy eating practices have been identified from various studies since the early 1990's including the contradiction in messages received, the cost of food (Lloyd et al, 1995), the choice and availability of foodstuffs (Barnes and Terry, 1991, cited in Kearney et al, 1999), access to a healthy and varied diet (Lobstein, 1997), the taste of food where people anticipate that a healthy diet will be unpalatable and boring (Holm, 1993), poor knowledge of healthy eating, poor culinary skills, low confidence, and a wide range of social issues (Kearney & McElhone, 1999). Age, employment, gender, smoking and marital status all affect attitudes towards accessing healthier options, affordability of healthier items and motivation to eat fruit and vegetables (Dibsdall et al, 2003). Environmental factors such as peer pressure, advertising and other cultural determinants may also prevent people from making the recommended changes. Social and cultural factors including religious dietary restrictions can impact on dietary intake (Tedstone et al, 1998). It should be noted that the determinants of food choice are often complex and multifactorial. The following chapter discusses the identified barriers to eating a healthy diet, many of which are associated with lower socio-economic groups. A convincing causal relationship between barriers associated with low Socio-Economic Status and diet quality still remains to be established (Darmon & Drewnowski, 2008), and further research is required to compare the perceived barriers across different social class groups.

1.4.1 Dietary Differences between Socio-Economic groups

There are several known barriers that prevent people from making healthier choices, many of which are largely associated with low socio-economic populations. Nelson et al, 2007 found that 35% of men and 44% of women living in areas with high levels of deprivation would like to eat a healthier diet but do not have the perceived means. There is a well-documented inequality between those on higher and lower incomes with regard to dietary intake in the UK (Acheson, 1998), where higher quality diets including whole grains, lean meats, fish, low-fat dairy products, and fresh vegetables and fruit are more likely to be consumed by groups of higher socio-economic status. As far back as 1986, the dietary and nutritional survey of British adults indicated a 4-fold difference in the consumption of whole grains between non-manual and manual social classes (Office of Population Censuses and Surveys, 1991; Thane et al, 2007). Energy-dense diets with refined grains such as white bread, pasta, and rice, fatty meats, processed foods and added fats that are nutrient-poor are associated with areas of lower socio-economic status and those with limited economic means (Nelson et al, 2007).

In areas of lower socio-economic status there is greater emphasis on obtaining the maximum amount calories per pound spent and reducing waste, and because trying a new food represents a risk of waste, diets of low-income households are often monotonous (Dowler, 1997). Most notably, people in lower socio-economic groups tend to eat less fruit and vegetables than those from more affluent classes. Higher socio-economic groups are more likely to consume vegetables and fruit, particularly fresh, not only in higher quantities but also in greater variety. This is possibly due to the high water content and very low energy density of vegetables and fruit, which makes them expensive sources of energy for people on a limited budget (Darmon et al, 2005). The 1997 National Food Survey (Ministry of Agriculture, Fisheries and Food, 1998) found that consumption of fruit and vegetables by those in the higher socio-economic groups was a third higher than that of those in lower groups. Research indicates that intake of fruit and vegetables has increased over the last 20 years, but not to a satisfactory level, and that those most resistant to change are those from areas of low socio-economic status (Nelson et al, 2007).

As a result of poor dietary intake including inadequate intake of fruit and vegetables, the intake of some vitamins and minerals also follow a socio-economic gradient. Research indicates that higher socio-economic groups have consistently higher intakes of most vitamins and minerals and fibre than lower socio-economic groups. Research shows that people from areas of low socio-economic status had the lowest consumption of Vitamin C, ß-carotene, and folate, Vitamin E, iron, calcium and potassium, and plant-based polyphenols, and that dietary intakes of Vitamin C, folate, and iron are often insufficient to meet dietary recommendations (James et al, 1997; Shimakawa et al, 1994; Hulshof et al, 2003; Hulshof et al, 1991; Bates et al, 1999). Lower intakes of Vitamin D have also been observed among children and adolescents from disadvantaged communities (Serra-Majem et al, 2002; Haapalathi et al, 2003; Laitinen et al, 1995 as cited in Darmon & Drewnowsky, 2008).

Although research indicates that micronutrient intake is affected by socio-economic status, there is little evidence to indicate that socio-economic status affects either total energy intakes or the macronutrient composition of the diet. The association found between socio-economic status and energy intakes and macronutrient composition of the diet intakes was either not statistically significant or inconsistent, with no consistent socio-economic gradient observed for total fat intakes. Some studies showed evidence of a higher fat intake among low socio-economic groups (Hulshof et al, 1991, Smith et al 1992, Hjartaker et al, 1998; Friel et al, 2003); however, an equally large number of studies found no significant differences (Galobardes et al, 2001; Roos et al, 1996; Hulshof et al, 2003).

1.4.2 Financial barriers

There is research to indicate that diet quality follows a socio-economic gradient. Some studies indicate that low income not only restricts the ability to buy foods rich in protective nutrients, but also limits the access to food retailers where healthy food can be purchased more cheaply (Dowler and Calvert, 1995; Mayall, 1986). Research by Turrell et al (2003) found that respondents in lower socio-economic groups were less likely to purchase grocery foods that were high in fibre and low in fat, salt and sugar, and purchased fewer types of fresh fruits and vegetables, and less often, than their counterparts from more advantaged backgrounds. The food purchasing behaviours of socio-economically disadvantaged groups were also less likely to follow dietary guideline recommendations.

Diets composed of low energy density, nutrient-rich foods such as lean meats, fish, or fresh fruit and vegetables are more expensive per calorie than are diets composed of refined grains, added sugars, and added fats that are both energy rich and shelf stable. Low-cost, high energy foods made from poor quality ingredients such as fast food, and items with a long shelf life such as dry packaged foods are likely to be less nutrient dense, but are more likely to satisfy hunger and are more affordable and more accessible in low-income areas. Several studies have indicated that food budgets in areas of low Socio-Economic Status are insufficient to obtain a balanced diet and that even when low-income groups develop efficient purchasing strategies, the available food budget may not be adequate to obtain the recommended diet (Turrell et al, 2003; Darmon & Drewnowski, 2008). A study based on the US Department of Agriculture Thrifty Food Plan reported that the cost of substituting healthier foods cost up to 35–40 % of an American low-income family's food budget (Jetter et al, 2008, cited in Dramon & Drewnowski, 2008). In the Whitehall II survey (1997), employment grade was directly associated with sharply higher intakes of Vitamin C (Stallone et al, 1997). Similar trends were observed for fibre and for other nutrients found in vegetables and fruit (Stallone et al, 1997; Bates et al, 1999). In a study by Andrieu et al (2006) participants that had the highest energy intakes also had the lowest daily intakes of key vitamins and micronutrients, which can possibly be attributed to consumption of low cost, high calorie, low nutrient foods such as processed and fast food.

A 1997 EU study, which looked at barriers to healthy eating in all socio-economic groups, found that 23 % of UK respondents reported price as an important barrier to healthy eating (Lappalainen et al, 1997). The Food Standards Agency Low Income Diet and Nutrition Survey (Nelson et al, 2007) also found that 30 % of men and 29 % of women reported that “price, value and money available for food” was the most important influence on their choice of food.

1.4.3 Access and availability

Some studies have viewed physical proximity to healthy food choices as the chief influence on diet quality. Easy access to supermarkets was shown to be associated with a higher intake of fruit and vegetables and the quality of food choices is directly influenced by the ease of access to a supermarket as well as to the availability and variety of healthy foods in neighbourhood stores (Darmon & Drewnowski, 2008). It has been suggested that low-income families are less likely to own a car and may find it more difficult to reach out-of-town supermarkets, in urban as well as in rural areas. However, research indicates that only about 50 % of people from areas of low Socio-Economic Status had access to a private car for shopping (Nelson et al, 2007) and yet approximately 80 % of people from these areas did their main shopping at a large supermarket. This is possibly due to access to public transport such as bus routes.

A 2003 study by Dibsdall et al found that few participants experienced difficulty in visiting a supermarket at least once a week, despite nearly half having no access to a car for shopping. Fruit and vegetables were affordable to this low-income group in the amounts they habitually bought. However, purchasing additional fruits and vegetables was seen as prohibitively expensive. Whereas supermarkets and more established grocery stores are more likely to be situated in the more affluent neighbourhoods, some lower-income neighbourhoods have been characterized as 'food deserts'. The term 'food desert' was coined in the mid-1990s to describe 'those areas of inner cities where cheap, nutritious food is virtually unobtainable. Car-less residents, unable to reach out-of-town supermarkets, depend on the corner shop where prices are high, products are processed and fresh fruit and vegetables are poor or non-existent'**.** However, although it has been suggested that food deserts are more likely to be found in deprived areas there has been little systematic research on their prevalence and distribution. A preliminary analysis of the location of food outlets in the Greater Glasgow Health Board Area by Cummins and MacIntyre (1999) did not find any evidence for the existence of food deserts, and found that food stores were more numerous in the more deprived localities and postcode districts in Greater Glasgow area.

Also, in contrast to the perceived barriers related to access to affordable items, a study that looked at the price and availability of food items in Glasgow (Cummins and Macintyre, 2002) found that shop type was the main predictor of food price and availability, whereby cheaper prices and greater availability of food items were mainly found in multiple and discount stores, and that these stores were more likely to be located in more deprived rather than affluent areas. They also found that prices did not vary greatly by area of deprivation and, when they did, they tended to be lower in more deprived areas. However, foods that were cheaper in areas of low socio-economic status were generally high-fat, high-sugar food items. More research is required in other areas to determine availability and cost of healthy items in areas of deprivation compared to items purchased from a supermarket. Further research is also required to determine if there is still an existence of 'food deserts' in disadvantaged communities.

1.4.4 Knowledge, awareness, skills and confidence

Studies have determined lack of nutrition knowledge and lack of cooking skills as key barriers to healthy eating, and it is widely considered that knowledge, confidence and culinary skills are eroded through long term reliance on low cost, low quality processed foods, and the removal of a compulsory home economic programme in council sector secondary schools. In research cited by Kearney & McElhone (1999), the most important barrier contributing to poor dietary habits was 'lack of knowledge'. However, 91 % of women and 64 % of men reported they could cook a meal from basic ingredients without help according to the Food Standards Agency Low Income Diet and Nutrition Survey (2006). Even when knowledge of healthy messages is present and there is access to healthier food items, healthy eating behaviour does not always occur. For example, the Dibsdall et al (2003) study 'Low-income consumers' attitudes and behaviour towards access, availability and motivation to eat fruit and vegetables', found that less than 5 % of the cohort felt they had a problem with eating a healthy diet, and yet only 8 % claimed to eat the recommended five or more portions of fruit and vegetables every day.

The Food and You survey, 2010 (Prior et al, 2011) commissioned by the Food Standards Agency found that although 90 % of participants in Scotland agreed with a number of statements about healthy living, such as eat fruit and vegetables (97 %); do physical activity (95 %); drink water (95 %), eat less salt (94 %), keep to a healthy weight (93 %), eat breakfast every day (92 %); limit food and drinks high in sugar (91 %), and limit foods high in total fat (91 %), awareness of the types and proportions of foods needed for a healthy balanced diet was low; only 19 % of respondents placed all food types in their correct proportions on the 'eatwell' plate, and food groups least likely to be placed correctly were protein sources and starchy foods. The study also found that awareness of maximum daily intakes of nutrients such as salt, total fat, saturated fat and calories was low, with the majority of respondents either answering don't know (41 %) or giving an incorrect answer (47 %) when asked their knowledge of recommended maximum intakes for salt. Two-thirds of participants did not know the recommended maximum intakes for total fat and saturated fat. In addition, 15 % of participants did not know how many portions of fruit and vegetables are recommended daily (Prior et al, 2011).

A misguided perception of body weight has also been identified as a barrier to healthy eating. According to research carried out by Hesketh et al (2005), only 11.5 % of parents of children who are obese or overweight recognise that their child has a weight issue. In addition, the 1999 IEFS Pan-EU survey found that a major obstacle to nutrition education is the fact that 70 % of EU subjects believe their diets are already healthy, and do not need to make any changes to their current dietary intake, which is clearly not the case, given the prevalence of overweight, obesity and related co-morbidities.

1.4.5 Educational levels, illiteracy and language barriers

Resistance to change, as a barrier, represents a significant obstacle among those with primary level education in the United Kingdom. A study by Monsivais & Drewnowski, (2008) determined that 'a better quality diet was generally consumed by people with a higher level of education'. Data from the ALSPAC study shows that mothers in higher educational groups are more likely to respond to health messages (Emmett et al, 2002). Similar findings from Robinson et al (2004) showed that educational attainment was the most important factor related to the diet score. Low diet scores were characterized by low intakes of 'healthier choices' such as fruit and vegetables, wholegrain bread, rice and pasta, yogurt, and breakfast cereals, and high intakes of 'less healthy options' such as chips and roast potatoes, sugar, white bread, red, and processed meat and full-fat dairy products. In all, 55 % of women with no educational qualifications had scores in the lowest quarter of the distribution, compared with only 3 % of those who were educated to degree level, which is possibly linked to illiteracy. Finally, research indicated that men and women with a lower level of educational achievement tended to have a 'less healthy' diet than men and women with more education. Nelson et al, 2007 found that men and women who had less educational achievements ate fewer vegetables and more chips, fried and roast potatoes, and that less educated women also consumed less fruit and fruit juice.

1.4.6 Psychological and behavioural issues

Historically, the Public Health approach to dietary changes has been based on the premise that consumers will abandon dietary behaviours that are demonstrated as unhealthy in order to prevent future illness. Although the assumption that knowledge shapes behaviour may appear self-evident, evidence suggests that providing information about risk does not have much effect on food behaviour unless it can overcome counteracting psychosocial and behavioural barriers. Eating behaviours are acquired over a lifetime so changing these behaviours requires alterations in habits that must be continued permanently (Nestle, 1998). Research suggests that intentions to change behaviour may be insufficient to produce sustained change without external support. Starting and maintaining behavioural change requires the belief that one has the psychological and other resources to make the desired change. Self-efficacy may be more difficult to achieve in areas of low socio-economic status. For instance, more deprived areas may lack shops selling healthy foods at competitive prices, reducing healthy dietary choices and disabling the ability to make the desired change even if the person expressed readiness to change (Health Behaviour Parliamentary Office of Science and Technology, 2007).

While people may be aware of the key nutrition messages they do not perceive these messages as personally relevant to themselves. A number of studies that found that the correlation between perceived and actual fat intakes was low (Bruj et al, 1993) and that people tended to underestimate their fat intakes believing their intakes to be lower than they actually were (Brug et al, 1994; Paisley et al, 1995). This behaviour is known as optimistic bias and indicates an unrealistic optimism in self-perception of diet quality (Raats and Sparks, 1995). In a UK based study by Mela (1993) consumers were also found to be poor at estimating the fat content of various high- and low-fat foods (Mela, 1993).

Studies of dietary habits of lower socio-economic groups have determined a range of barriers to healthy eating such as lack of motivation, and a general disinterest in cooking, and apathy toward nutrition prevention messages**.** In a UK survey conducted in which over 200 health professionals were asked for their opinions regarding the public's most common barriers to changing their diet, apathy was considered the most important barrier. Poverty is often accompanied by isolation, boredom, and depression and these are behaviours that may encourage snacking, simplifying or skipping meals. Monotonous diets have the added disadvantage of being unpalatable and may be regarded as unsatisfying and unpleasant (Holm, 1993; Rudat et al, 1992; Darmon & Drewnowski, 2008).

1.4.7 Time

Limited time for food shopping and cooking is an important factor influencing food intake among low-income mothers (Darmon and Drewnowski, 2008). Healthier foods are associated with increased time costs and high energy density diets are associated with lower time costs per kcal.

1.4.8 Fast food culture

An ecological study by Reidpath et al (2002), in which the relationship between an area measure of socio-economic status and the density of fast-food outlets was examined found that people living in areas from the poorest SES category have 2.5 times the exposure to outlets than people in areas of the highest SES. A study by Cummins et al (2005) found statistically significant positive associations were found between neighbourhood deprivation and the mean number of McDonald's outlets per 1,000 people for Scotland and England. These associations were broadly linear with greater mean numbers of outlets per 1,000 people occurring as deprivation levels increased (Cummins et al, 2005). MacDonald et al (2007) also found statistically significant increases in density of outlets from more affluent to more deprived areas for each individual fast-food chain and all chains combined. These results provide support for a 'concentration' effect whereby plausible health-damaging environmental risk factors for obesity appear to be 'concentrated' in more deprived areas of England and Scotland.

1.4.9 Marketing and advertising

The way in which food is advertised can influence food preferences (Dibb, 1993). Clever marketing can lead to common misconceptions about what foods are healthy and which are unhealthy by parents. Findings from Hesketh et al (2005) showed that as a result, parents did not feel well equipped to distinguish between healthy and unhealthy pre-packaged snacks available and marketed to children. 'There's so much deception in marketing, it's hard to know which snacks are healthy' (parent).

1.5 Barriers to healthy eating (children)

Dietary patterns learned in childhood have an influence on dietary preferences and eating patterns in adolescence and adulthood (Kelder et al, 1994). Currently the dietary intake of children in Western societies, and particularly those from areas of low socio-economic status, is not nutritionally balanced. Research by Buttris (1995) indicated that 75 % of children aged 10 to 11 years were exceeding the recommended intake for fat intake. The National Diet and Nutrition Survey (Gregory et al, 1995) also indicated excessive intake of NME sugar in children. Children of obese parents are at much higher risk than children of normal weight adults of becoming overweight as they enter adolescence and adulthood (Wardle et al, 2001).

According to the Food Standards Agency Low Income Diet and Nutrition Survey (Nelson et al, 2007), 60 % of parents and parents wanted to change their children’s diet. However, parents who participated in a study by Hesketh et al (2005) identified many barriers including financial resources and household income, knowledge, beliefs and food preferences of mothers and secondary carers, children’s exposure to particular foods and experimentation with tasting a range of foods, social and cultural norms about foods and appropriate infant feeding, and food marketing and advertising. The contradictions in messages children receive were also reported to be a barrier to a healthy lifestyle.

1.5.1 Knowledge and awareness

Children of school age are generally knowledgeable about healthy and unhealthy foods, but can be confused by multiple messages on the same topic i.e. fries are healthy because they are a potato which is a vegetable, fries have salt and fat so they are unhealthy. Research by Hesketh et al (2005) found that parents felt that their children understood the difference between healthy and unhealthy foods, but were unaware of the consequences of a poor diet. Children believed that products labelled ‘diet’ were healthy, and that foods derived from natural products were healthy regardless of the content of the final product; Children also reported that eating fruit before junk food counterbalances the effects of junk food, and that salt is good for you because it helps your blood flow.

1.5.2 Food preferences and attitudes to a healthy diet

Research into food preferences indicates that taste is learned at an early age (Pliner, 1982) and that healthy eating habits formed in early years can influence preferences and practices in adolescence (Kelder et al, 1994; Singer et al, 1995; Resnicow et al, 1998).

Faddy eating, which is recognised as a normal developmental stage, is common in preschool children particularly at the age of 18 to 24 months (Benton, 2004). However, the earlier poor dietary habits are developed, the more difficult it becomes to make the lifestyle changes necessary to reverse the effect (Kelder et al 1994; Brown and Ogden, 2004; Benton 2004). Dental erosions of primary teeth begin, a taste for high salt, high fat, and high sugar foods is developed, and few fresh fruits or vegetables are subsequently accepted into the diet (Gregory et al, 1995).

Inappropriate weaning fails to introduce vegetables and fruits within the critical period needed to establish dietary tastes; instead, early use of sweet and salty foods stimulates the primary taste buds and develops a taste for less healthy foods at an early age (Benton, 2004). This is amplified by parental reward systems using sweets, biscuits, cakes, soft drinks, sweetened yoghurt, and highly seasoned foods such as crisps (Benton, 2004). All parents in the Hesketh study believed it was important to allow their children 'treats'. However, research indicates that encouraging unhealthy foods as 'rewards' can make these foods seem more appealing, especially when the 'reward' foods are also the 'restricted foods', and when children are free to make a choice they are more likely to select the 'restricted food item', particularly when the mother is not present (Birch et al, 1991).

Maternal knowledge and beliefs, food preferences and choices may all affect the dietary intake of children (Mennell et al, 1992, Murphy et al, 1998). Wardle (1995) concluded that 'parental attitudes affect their children indirectly through the foods purchased for and served in the household…influencing the children's exposure and…their habits and preferences' (cited in Brown and Ogden, 2004). There is a correlation between mothers' and children's' food intakes for most nutrients in pre-school children (Olivera et al 1992). Research also indicates that children model their parents' intake, attitude and preferences (Brown and Ogden, 2004). In the Hesketh et al study (2005), children clearly exhibited a preference for the less healthy foods: 'I'd like to eat [fast food] everyday'; 'it would be good if they could make broccoli taste good like chocolate'. Many children suggested that 'junk foods are irresistible' and 'unhealthy food tastes good and is addictive', but described their meals at home to be predominantly healthy. Parents were aware that their family diet and activity levels were not as healthy as they would like, despite their knowledge and awareness of what comprises a healthy lifestyle. However, they were conscious of not wanting to be 'too restrictive' on the types of food they permitted their children to consume (Hesketh, 2005).

1.5.3 Marketing and advertising

Inconsistent messages about unhealthy energy-dense foods, including attractive marketing and advertising strategies, confuse children. Advertising and packaging of unhealthy foods, celebrity endorsements, and product placements in toys, games, educational materials, songs and movies make brands more recognizable to children (Nestle, 2006). Toys, games and 'rewards' that come with cereals and fast foods also add to appeal. Parents reported that demands and pressure from their children as a result of advertising and peer pressure from other children were the main barriers to healthy eating (Hesketh et al 2005).

1.6 Dietary Reference Values for the United Kingdom

Nutrients and energy are required for daily activity, growth and repair. The Scientific Advisory Committee for Nutrition (SACN), previously the Committee on Medical Aspects of Food Policy (COMA), is responsible for determining the Dietary Reference Values (DRV's) for food energy and nutrients for groups of people in the United Kingdom. The Dietary Reference Values for the United Kingdom were published 1991, aspects of which were updated in 2011, and again in 2015, and continue to be monitored by the SACN team of leading experts, who use evidence-based scientific research to determine the nutritional needs according to age, gender and additional nutritional requirements (e.g. pregnancy and lactation). DRV's have been developed for ages 0 to 3 months, 4 to 6 months, 7 to 9 months, 10 to 12 months, 1 to 3 years, 4 to 6 years, 7 to 10 years, 11 to 14 years, 15 to 18 years, 19 to 50 years, 51 to 59 years, 60 to 64 years, 65 to 74 years, and 75 + years for both males and females.

Estimated Average Requirements (EAR) has been determined for energy (kcal or KJ) and macronutrients (carbohydrate, NME sugar, fat and saturated fat) as % daily energy intake (when including alcohol) and as % daily food intake (not including alcohol). Reference Nutrient Intakes (RNI) have been determined for protein (g/d), vitamins and minerals (mg or µg/d), and are set at 2 standard deviations (2sd) above the EAR and represent adequate intakes for 97.5% of the specified population group. A Lower Reference Nutrient Intake (LRNI) for protein (g/d) or micronutrients (mg or µg) is set to 2sd below the EAR and represents the lowest intakes that will meet some of the individuals in the specified population group. Intakes below this level are almost certainly inadequate for most individuals in the specified population.

1.6.1 Adult recommendations

At the time that this research was carried out, the UK recommendation for energy intake for females aged 19 to 50 was 1,940 kcal/d, which was the recommendation given to the participating families in the intervention group at the time that the research was carried out, and has been used as the EAR to which the data collected in this research has been compared. The EAR for adult females has since been updated to 2,103 kcal/d (age 35 to 54) and 2,175 kcal/d (age 19 to 34) (Scientific Advisory Committee on Nutrition, 2011). The Dietary Reference Values for fat and carbohydrate for adults as a percentage of daily total (and food) energy at the time of this research was as follows: approximately 47 % (50 %) from carbohydrate sources of which no more than 10 % (11 %) should be non-milk extrinsic (NME) sugar; and no more than 33 % (35 %) from fat sources, no more than 10 % (11 %) of which should be derived from saturated fat sources. In 2015, the Scientific Advisory Committee on Nutrition increased the dietary reference value for carbohydrate to 50 % of total dietary energy, and replaced the recommendation for % energy intake from NME sugar; the updated recommendation is that no more than 5 % intake of energy should come from 'free sugar', which can be defined as "all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices" (Scientific Advisory Committee on Nutrition, 2015). The Reference Nutrient Intake for protein for adult females is 45 g/d. At the time of this research, the recommended intake of non-starch polysaccharides (NSP) was 18 g/d. This has since been replaced with a recommendation for dietary fibre intake of 30 g/d (Scientific Advisory Committee on Nutrition, 2015), which "should be chemically determined using the prevailing AOAC methods agreed by regulating authorities". The SACN definition of dietary fibre is "all carbohydrates that are neither digested or absorbed in the small intestine and have a degree of carbohydrate components of three or more monomeric units, plus lignin". The previous dietary reference value of 18 g/d NSP, which was defined by the Englyst method, equates to about 23 to 24 g/d of dietary fibre; therefore the new dietary reference value represents an increase in recommended fibre intake (Scientific Advisory Committee on Nutrition, 2015). NHS recommendations for salt intake for adults are no more than 6 g/d (National Health Service, 2015). Intakes for adult females aged 19 to 50 years of the micronutrients that were researched in this thesis are as follows: Vitamin A 600 µg/d; folate 200 µg/d; Vitamin C 40 mg/d; calcium 700 mg/d; iron 14.8 mg/d; zinc 7 mg/d (Department of Health, 1991).

1.6.2 Preschool recommendations

Nutrition in the early years is essential for optimal growth and health. For infants below the age of two years, a balanced and appropriate diet is essential for growth and development, and has more significant and lasting impact on health and nutrition than at any other age (De la Hunty et al, 2000). Requirements per kilogram body weight are much higher at this age. For example at the age of one year, protein requirements are double, Vitamin C requirements are five-fold and iron requirements are 6.5 fold the requirements of adults. This is because infants are growing and developing at a much faster rate than older children and adults (Department of Health 1991). In order to meet energy and nutrients requirements, the SACN has determined that children below the age of six require a variety of foods.

At the time that this research was carried out, the recommended EAR for energy at age one to three years was 1,230 kcal per day for males and 1,165 kcal per day for females, increasing to 1,715 kcal per day for males and 1,545 kcal per day for males at age four to six years. Energy requirements for children were updated in 2011 with an established EAR for each age. The recommendation for boys and girls aged 3 years is 1,171 and 1,076 respectively, and for boys and girls aged five 1,482 and 1,362 respectively (Scientific Advisory Committee on Nutrition, 2011). SACN 2015 guidelines state that by the age of two years, the breakdown of the diet should be in line with adult recommendations of 50 % energy from carbohydrates, with no more than 5 % derived from 'free sugar'; 35 % energy from fat, with no more than 10 % derived from saturated fats, and supplemented with Vitamin A and Vitamin D where necessary (Department of Health, 1991; Scientific Advisory Committee on Nutrition, 2015). The RNI for protein for children aged 3 years is 14.5 g/d, and 19.7 g/d for children aged 4 to 6 years. The updated 2015 SACN 'Carbohydrate and Health' report includes a guideline of 15 g/d dietary fibre intake for children aged 2 to 5 years (Scientific Advisory Committee on Nutrition, 2015). It is recommended that the diet be low in salt; less than 2 g/d for children aged three or less, and less than 3 g/d for children aged three to five years (National Health Service, 2015). The micronutrient requirements for this age group are as follows: Vitamin A 400 µg/d; folate 70 µg/d; Vitamin C 30 mg/d; calcium 350 mg/d; iron 6.9 mg/d; zinc 5 mg/d (Department of Health, 1991).

1.7 Why 5 a day?

A key feature in the Governments' framework for reducing early deaths from cardiovascular disease, diabetes and cancer, reducing rates of obesity and reducing health inequalities among the general population is to improve access to and increase the consumption of fruit and vegetables. Current Government recommendations for adults are five portions of a variety of fresh, frozen, tinned or dried fruit and vegetables each day, to reduce the risks of coronary heart disease and some cancers (Department of Health, 2003). These recommendations are based on World Health Organisation recommendations that 400 g of fruit and vegetables provides optimal micronutrients and fibre to prevent the 2.7 million deaths which are attributed to low fruit and vegetable intake globally each year (World Health Report, 2002). Although there is no defined amount (g) for children under the age of five, the corresponding recommendation for children equates to five portions of equivalent size i.e. five 'handfuls' of fruit or vegetables. Further discussion on children's portion sizes can be found in section 3.5.4.

1.7.1 Key nutrients found in fruit and vegetables

Fruit and vegetables contain many nutrients that are essential to maintain health, break down energy yielding nutrients and fight infection. Many fruits and vegetables are rich in dietary fibre, antioxidants, vitamins including folate, β-carotene and carotenoids, Vitamin C and Vitamin E, and minerals such as iron, zinc, potassium and calcium. Vegetables are also naturally low in fat and calories, and can therefore help to maintain a healthy weight. Folate is essential for a healthy pregnancy, as it is involved in DNA synthesis and neural tube fusion, which prevents medical conditions such as spina bifida. It is found in fruits including broccoli, spinach, green peas, avocado, tomato juice, orange juice, oranges, turnip greens, cantaloupe, and bananas (Bender, 2005). The carotenoid group alone consists of over 500 antioxidants, including lycopenes, found in tomatoes, and β-carotene, found in carrots and orange coloured fruit and vegetables, and the most common precursor to Vitamin A. Vitamin C, found in abundance in berries and citrus fruits, is an essential antioxidant in the body, and is required for the prevention of the medical condition 'scurvy'. Vitamin C is an essential component of collagen and assists with the elasticity of blood vessels and the skin. Vitamin C is also essential in the absorption of Non Haem Iron (Bender, 2005). Iron is found in dark green leafy vegetables. It is required in the body as a constituent of haemoglobin, a protein structure responsible for the transport of oxygen around the body. Zinc, which is found in some fruits such as berries, is essential for reproduction (Sharp, 2005). Apart from being rich sources of dietary fibre, antioxidants and other bioactive factors, fruit and vegetables are also rich sources of potassium, which is associated with lower blood pressure and a lower risk of stroke (Joshipura et al. 1999) and calcium, which is essential in bone health (Sharp, 2005).

Fibre, which is found in fruit and vegetables, is essential for the transit of foods through the gastrointestinal tract. There are two sub-groups of fibre; soluble fibre, such as the pectin found in the flesh of fruits, and insoluble fibre, such as that found in the skin of fruit and vegetables. Both are essential for bulking out faecal waste and maintaining healthy transit of food waste through the body. A diet low in dietary fibre can lead to conditions such as constipation, haemorrhoids, diverticulitis and eventually colon cancer (World Health Organisation, 2012).

1.7.2 Fruit, vegetables and cardiovascular disease

According to the World Health Organisation (2012), cardiovascular disease is the leading cause of death in middle and high-income countries. Many risk factors for cardiovascular disease, including high blood cholesterol, hypertension, obesity, and diabetes are substantially influenced by dietary factors. There is evidence to suggest that diets low in fruits, vegetables, whole grains and pulses are associated with an increased risk of heart disease. In addition, diets high in micronutrient, phytochemical, fibre and antioxidant containing foods such as fruits and vegetables can have a protective effect on the heart and cardiovascular system. Research indicates that populations with lower intakes of animal products and higher intakes of fruit and vegetables have lower prevalence of cardiovascular disease than populations with higher intakes of animal products (Liu et al, 2000, Ness et al 1997). In a study involving a large-scale prospective cohort of women, Liu et al (2000) found an inverse association between fruit and vegetable intake and risk of cardiovascular disease. A study of 2,641 Finnish men by Rissanen et al (2003) found that a high fruit, berry and vegetable intake is associated with reduced risk of mortality in middle-aged men. Ness et al (1997) and Dauchet et al (2006) found a strong protective effect of fruit and vegetables against stroke and coronary heart disease. Research also indicates the impact of specific antioxidant vitamins on cardiovascular disease. In a study of 5,133 Finnish men and women aged 30 to 69 years of age, an inverse association was observed between dietary Vitamin E intake and coronary mortality (Knekt et al, 1994). Similar associations were observed for the dietary intake of Vitamin C and carotenoids among women, and for the intake of important food sources of these micronutrients, i.e. vegetables and fruits, among both men and women (Knekt et al, 1994); researchers determined that associations were not attributable to non-dietary risk factors of coronary heart disease, i.e., age, smoking, serum cholesterol, hypertension, or relative weight. Gaziano et al (1995) found, in a study of 1299 elderly men and women, that for total cardiovascular disease, death and fatal myocardial infarction, risks were lower among those residents in the highest quartile for consumption of carotene-containing fruits and vegetables as compared with those in the lowest. This data is compatible with the hypothesis that increased dietary intake of carotenoids decreases the risks of CVD mortality (Gaziano et al 1995).

1.7.3 Fruit, vegetables and cancer

There is evidence to suggest that diets low in fruits, vegetables, whole grains and pulses are associated with an increased risk of cancer such as colon, stomach and breast cancer, and that a diet high in fruit and vegetables can have a protective effect against some cancers. However, there is still debate as to which constituent of fruit and vegetables are most effective against which cancers and whether there is any benefit to supplements of these constituents as opposed to consuming the actual fruit or vegetable in its' natural state.

In a review of the scientific literature on the relationship between vegetable and fruit consumption and risk of cancer by Steinmetz & Potter (1996), results from 206 human epidemiologic studies and 22 animal studies found evidence of a protective effect of greater vegetable and fruit consumption was consistent for cancers of the stomach, oesophagus, lung, oral cavity and pharynx, endometrium, pancreas, and colon. The types of vegetables or fruit that most often appeared to be protective against cancer were raw vegetables, followed by allium vegetables, carrots, green vegetables, cruciferous vegetables, and tomatoes, and the substances present in vegetables and fruit, such as allium compounds, isoflavones, phytosterols, Vitamin C, D-limonene, lutein, folic acid, beta carotene, lycopene, selenium, Vitamin E, flavenoids, and dietary fibre (Steinmetz & Potter, 1996).

Analysis of research by Gandini et al (2000) found an association between intake of vegetables and, to a lesser extent, fruits and breast cancer risk from published sources. Researchers concluded that increasing vegetable consumption might potentially reduce the risk of breast cancer. In an analysis of case control studies that focused on the frequency of consumption of vegetables and fruit and cancer risk conducted in Italy from 1983 to 1998, La Vecchia and Tavani found evidence to indicate that high intakes of fruit and vegetables are associated with a reduced risk of a variety of cancers, and most particularly epithelial cancers. Association between fruit and vegetable consumption and reduced relative risk was stronger for cancers of the digestive and respiratory tracts, and weaker for hormone-related cancers. Findings indicated that fruit was related to a reduced relative risk for cancers of the oral cavity and pharynx, oesophagus, stomach, larynx, as well as of the urinary tract, and there was a specific and consistent pattern of protection by tomatoes, a typical Mediterranean food, most notably for gastrointestinal neoplasms. Researchers concluded that increasing fruit and vegetable consumption could lead to a substantial reduction in risk of cancer, and particularly epithelial cancers (La Vecchia and Tavani, 1998).

Analysis of data from the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort from 1992 to 2000 to assess relationships between intake of total fruits, total vegetables, total fruits and vegetables combined, and cancer risk was carried out by Boffetta et al, who concluded that "…a very small inverse association between intake of total fruits and vegetables and cancer risk was observed... given the small magnitude of the observed associations, caution should be applied in their interpretation" (Boffetta et al, 2010). Furthermore, Koushik et al (2012) suggest that although most case-control studies have found inverse associations between fruit and vegetable consumption and risk of pancreatic cancer, results from a pooled analysis of 14 cohort studies indicate that fruit and vegetable intake during adulthood is not associated with a reduced pancreatic cancer risk (Koushik et al, 2012).

A study of postmenopausal breast cancer and intake of Vitamin A, Vitamin C and Vitamin E found no statistically significant evidence that intake of these Vitamins is associated with reduced breast cancer risk (Kushi et al, 1996). Hutchinson et al (2012) compared reported Vitamin C intake to risk of breast cancer. Researchers found no significant association between breast cancer incidence, and Vitamin C intake. Contrastingly, research by Zhang et al (1999) concluded that consumption of fruits and vegetables high in specific carotenoids and vitamins may reduce premenopausal breast cancer risk. Research that examined associations between intakes of specific carotenoids, Vitamin A, Vitamin C and Vitamin E, consumption of fruit and vegetables with breast cancer risk in a cohort of 83,234 women aged 33 to 60 years found that intakes of β-carotene from food and supplements, lutein/zeaxanthin, and Vitamin A from foods were weakly inversely associated with breast cancer risk in premenopausal women. Strong inverse associations were found for increasing quintiles of α-carotene, β -carotene, lutein, total Vitamin C from foods, and total Vitamin A among premenopausal women with a positive family history of breast cancer. Premenopausal women who consumed five or more servings per day of fruits and vegetables had modestly lower risk of breast cancer than those who had less than two servings per day; this association was stronger among premenopausal women who had a positive family history of breast cancer (Zhang et al, 1999).

There is some evidence that lycopenes, found predominantly in tomatoes, have a protective effect against risk of prostate cancer. Data from the Health Professionals Follow-Up Study (HPFS) involving 47,365 participants over a 12-year period was analysed by Giovannucci et al (2002) to compare the frequency of lycopene intake with diagnosis of prostate cancer. Researchers concluded that "frequent consumption of tomato products is associated with a lower risk of prostate cancer"… but that "the magnitude of the association was moderate enough that it could be missed in a small study or one with substantial errors in measurement or based on a single dietary assessment". This research supported previous research by Gann et al (1999), that lycopenes are "the carotenoid with the clearest inverse relation to the development of prostate cancer", and that the inverse association was particularly apparent for aggressive cancer and for men not consuming β-carotene supplements". Researchers concluded that increased consumption of tomato products and other lycopene-containing foods might reduce the occurrence or progression of prostate cancer (Gann et al, 1999).

It has been suggested that β-carotene have a protective effect against lung cancer. However, research by the Alpha-Tocopherol Beta Carotene Cancer Prevention Study Group (1994) looking at the impact of supplementation of alpha-tocopherol and β-carotene found that among the 876 new cases of lung cancer diagnosed during the trial, no reduction in incidence of lung cancer was observed among the men who received alpha-tocopherol. Furthermore, there was higher incidence of lung cancer among the men who received β-carotene than among those who did not. Research found that β-carotene had little or no effect on the incidence of cancer other than lung cancer. Alpha-tocopherol had no apparent effect on total mortality, although more deaths from haemorrhagic stroke were observed among the men who received this supplement than among those who did not. No reduction in the incidence of lung cancer was found among male smokers after five to eight years of dietary supplementation with alpha-tocopherol or β-carotene. This trial raised the possibility that supplements may actually have harmful as well as beneficial effects on risk of cancer (Alpha-Tocopherol Beta Carotene Cancer Prevention

Study Group, 1994). These findings are supported by Omenn et al (1996) who conducted a randomized, double-blind, placebo-controlled primary prevention trial involving a total of 18,314 smokers, former smokers, and workers exposed to asbestos. This study found that after an average of four years of supplementation, β-carotene had no benefit, and may have had an adverse effect on the incidence of lung cancer and on the risk of death from lung cancer and cardiovascular disease (Omenn et al, 1996).

1.7.4 Fruit, vegetables and type II diabetes

There is evidence to suggest that diets low in fruits, vegetables, whole grains and pulses, and high in red meats and processed foods, are associated with an increased risk of diabetes (Van Dam et al, 2002). Research looking at dietary patterns of 8,587 Japanese Americans and native Hawaiians concluded that foods high in meat and fat appear to confer a higher diabetes risk in all ethnic groups, vegetables lowered diabetes risk in men, and fruit lowered diabetes risk in women (Erber, 2010). Results from a prospective study of 64,191 women in China with no history of type II diabetes suggest that fruit intake was not associated with incidence of diabetes, and that vegetable consumption may protect against the development of type II diabetes (Villegas et al, 2008).

A meta-analysis of six studies in the UK showed that a greater intake of green leafy vegetables (increase of 1.15 servings per day) was associated with a 14 % reduction in risk of type II diabetes. Researchers concluded that increasing daily intake of green leafy vegetables could significantly reduce the risk of type II diabetes (Carter et al, 2010). This finding is supported by research by Liu et al (2004) who analysed dietary intake over a 10-year period of 38,018 female participants as part of the Women's Health Study (WHS) in Boston, US. Researchers concluded that there is no inverse association between total intake of fruits and vegetables and risk of incident type II diabetes after adjustment for known risk factors, and that a high intake of green leafy or dark yellow vegetables was associated with reduced risk of type II diabetes among overweight women (Liu et al 2004).

1.7.5 Fruit, vegetables and bone health

As long ago as 1968 it was suggested that a diet emphasising fruit and vegetables should be considered as an adjunct to therapy for Osteoporosis. Calcium, essential for bone health, can be found in abundance in green leafy vegetables, and renewed interest in fruit and vegetable intakes came with the publication of several studies showing a positive link with bone mineral density and fruit and vegetable consumption (cited in Prynne et al, 2006). Vitamin K also has an essential regulatory role in osteoblast differentiation; vegetables, and particularly alfalfa, are also the principle source of Vitamin K, which has a role in bone mineralisation (Prynne et al, 2006)

1.7.6 Fibre and health

Scheppach et al (2001) concluded that dietary fibre might play a role in the maintenance of digestive health and protect against diverticular disease. Several studies have found that a higher intake of dietary fibre is associated with lower risk of heart disease. A study by Van De Laar et al (2012) found that a lower lifetime intake of fibre during the course of young age is associated with carotid artery stiffness in adulthood (Van De Laar et al, 2012). Research by Liu et al (1999) indicated a strong inverse association between wholegrain intake and risk of both fatal and non-fatal coronary heart disease (CHD) in adult women, which was independent of both dietary and non-dietary coronary risk factors. Furthermore, intake of whole grains was positively associated with intakes of its constituents, such as dietary fibre, folate, Vitamin B6 and Vitamin E, which may all reduce risk of coronary heart disease (Liu et al 1999). These findings support current SACN recommendation to consume dietary fibre as a primary preventive measure against cardiovascular disease and other diseases. The SACN (2015) changed the 1991 Department of Health recommendation of 18 g/d NSP, which was calculated using the Englyst method to a minimum intake 30 g/d of dietary fibre for adults, calculated using the AOAC methods (see section 1.6.1). Dietary fibre can optimise intestinal health and potentially decrease total and LDL cholesterol concentrations in the body (SACN, 2015). There is also evidence that diets rich in dietary fibre are associated with a lower incidence of coronary events, some cancers, and type 2 Diabetes (SACN, 2015). A systematic review of 25 studies by Aune et al (2011) found that a high intake of dietary fibre, in particular cereal fibre and whole grains, was associated with a reduced risk of colorectal cancer. Dahm et al (2010) also concluded, from a case control study which included 579 case patients and 1,996 matched control patients, that intake of dietary fibre is inversely associated with colorectal cancer risk. However, a prospective study of 88,757 women aged 34 to 59 years of age found no association between the intake of dietary fibre and the risk of colorectal cancer (Fuchs et al 1999). Further research is required on the relationship between fruit and vegetables, and their constituents, and all types of cancer, to identify an absolute preventative mechanism.

1.8 What People Are Eating: Diet Survey Results

Over the past 20 years a number of studies and surveys, both national and regional have been carried out to identify the key issues in the diet of both adults and children in the UK, in Scotland, and in more specifically, in the city of Edinburgh. The following section aims to identify the key findings of studies that focused primarily on the diet of adults and children.

1.8.1 Low Income Diet and Nutrition Survey (2007)

The Low Income Diet and Nutrition Survey (LIDNS) (Nelson et al, 2007) provided strong, nationally representative evidence on the eating habits and nutrition-related health of people on low income in the United Kingdom. Objectives of the survey included provision of information on food and nutrient intakes, and assessment of how and to what degree diets of the low-income population vary from expert recommendations. Research was gathered from a total of 3,728 people from 2,477 households considered to be in the bottom 15% of the population in terms of material deprivation. Methods for gathering data included face to face interviews and self-completed questionnaire; four 24 hour dietary recalls carried out on random days (including at least one weekend day) within a 10 day period; anthropometrical measurements indicating height and weight, blood pressure, and a blood sample for those aged eight years old and over, to measure indicators of nutritional status.

The research found that, in general, the types and quantities of many food items eaten by people on low income appeared similar to those of the rest of the UK population, and where differences did exist, they were often consistent across different age groups. However, those on low income were less likely to eat wholemeal bread and vegetables, tended to drink more soft drinks (not diet drinks) and also tended to eat more processed meats, whole milk and sugar. The average number of fruit and vegetable portions eaten daily was 2.4 for men, 2.5 for women, 1.6 for boys and 2 for girls. As with the general population, fruit and vegetable consumption was found to be well below the Government's recommendation to eat at least five portions a day. Non Milk Extrinsic (NME) sugar intake accounted for 14% of food energy for adults and 17 % for children. In adults, the main sources of NME sugars were table sugar, preserves and confectionery (35 %, of which table sugar contributed 22 %). In children, the main source was soft drinks (not diet), which provided over 25 % of intake in children aged two to 10 years, and over 33 % in children aged 11 to 18 years. The mean daily intake of protein exceeded recommended levels in all sex and age groups. Total fat intakes as a proportion of food energy were broadly similar to those in the general population and in line with the EAR of 35 % energy intake. However, intakes of saturated fatty acids were above the EAR in all age groups.

With regards to Non Starch Polysaccharide (NSP), 51 % of men and 69 % of women consumed less than the recommended intake of 18 g/d. Mean intakes of all vitamins, with the exception of Vitamin A and Vitamin D, were above or close to the RNI for men and women in all age groups. However, average intakes of total iron, zinc and folate fell below the RNI for a large proportion of respondents. Women had a particularly low intake of iron. Mean daily consumption of salt from food sources only was about 7 g in men, and in women 5 g. Adults and children both received one third of their sodium intake (excluding salt added at the table or in cooking) from cereals and cereal products, the largest single contributor of which was white bread (12 %). The researchers concluded that it was likely that true salt intake (taking into account salt added to food) was in excess of the recommended intake of no more than 6 g per day for both men and women.

1.8.2 National Diet and Nutrition Survey 18 to 65 years

The most widely acclaimed and significant national research looking at the dietary consumption in adults from all socio-economic backgrounds is the National Diet and Nutrition Survey (NDNS), the most recent of which (at the time of the research to be described) was carried out over a 12-month period between July 2000 and June 2001. The survey consisted of a range of methods for gathering research including dietary interview, seven day weighed dietary intake, urine collection, physical measurements, seven-day physical activity record, and blood sample (Rustin et al, 2004).

The NDNS found that men and women consumed, on average, less than 3 portions of fruit and vegetables each day (2.7 portions a day for men and 2.9 for women), and only 13 % of men and 15 % of women met the Government 5-a-day recommendation. A high percentage (21 % of men and 15 % of women) consumed no fruit or vegetables during the 7 day period, with men and women in the 19 to 24 year old age group consuming the least; 45 % of men and 27 % of women in this age group ate no fruit or vegetables in the seven day period, and 38 % of men and 36 % of women consumed less than one portion of fruit in the seven-day period. The average consumption of fruit and vegetables for men was 1.3 portions per day in the 19 to 24 age group, 2.2 portions per day in the 25 to 34 year age group and 3 in the 35 to 49 year age group. The average consumption of fruit and vegetables by women was 1.8 portions per day in the 19 to 24 year age group, 2.4 portions per day in the 25 to 34 year age group and 2.9 portions per day in the 35 to 49 year age group. There were no significant differences in the amount of fruit and vegetables consumed by region. However, men and women in benefit-receiving households consumed on average 2.1 and 1.9 portions of fruit and vegetables respectively, compared to those from households that did not receive benefits, who consumed on average 2.8 and 3.1 portions of fruit and vegetables respectively. Finally, a lower proportion of women from benefit receiving households (4 %) met the five-a-day recommendation of fruit and vegetables compared to women from households that did not receive benefits (17 %) (Rustin et al, 2004).

Daily energy intake was below the EAR for both age and gender groups in the adult population. Average protein intakes were above the RNI for all gender and age groups and the average carbohydrate (CHO) intake was near to the recommended 50 % of energy. The mean percentage of total fat was close to the recommended 35 % of dietary intake. However, as with Nelson et al, 2007 the mean percentage of intake from saturated fats was higher than the recommended intake of 11 % in each age and gender group. NME sugar intake was high in all age groups with the exception of the oldest age group, and was highest in the 19 to 24 year old age group. In every region other than London and the South East, the daily intake of NME sugars in women was higher than the recommended ‘no more than 11 % energy’ intake. The research also found that women living in benefit claiming households were more likely to have a lower than average intake of energy and some micronutrients than women in a household that did not receive benefits, and that more of that energy was likely to come from NME sugars and less from protein sources. The mean NSP intake was below the previous recommendation of 18 g/d. Families in benefit households had less NSP intake than those from non-benefit households (Rustin et al, 2004).

Intake of micronutrients was low, particularly in the 19 to 24 year age group. In the youngest age group there were low intakes of Vitamin A in both the male and females. Research showed that 19 % of the women in the 19 to 24 year old age bracket, and 11 % of the women in the 25 to 34 year old age bracket consumed below the LRNI for Vitamin A. In addition, 42 % of women aged 19 to 24 and 41 % of women aged 25 to 34 consumed below the LRNI for iron. This survey indicated that 86 % of women aged 19 to 24 years, 92 % of women aged 25 to 34 years and 84 % of women aged 35 to 49 years had intakes of folate, from both natural and supplemented sources, below the recommended 400 μg per day. Families in benefit households had lower vitamin and mineral intakes than those from non-benefit households. Significantly more women from benefit households had intakes of Vitamin A below the LRNI (250 μg) than those in households that did not receive benefits, and more than half (53 %) of women aged 19 to 50 in the benefit households had iron intake below the LRNI (8 mg/d), compared with 29 % from households that did not receive benefits. Intakes of salt were higher than the recommended maximum of 6 g per day in all age and gender groups. Average salt consumption in men was 11 g per day, and average salt consumption in women was 8.1 g per day (Rustin et al, 2004).

1.9 What Children Are Eating: Early Years Diet Survey Results

There is little research that looks specifically at dietary intake and requirements of pre-school children in the UK, and even though substantial funding has been provided over the past two decades to develop a wide range of healthy eating initiatives, including fruit and vegetable based interventions to increase the amount of healthy food items eaten, there is limited data on what children at this age are currently consuming. Specifically, data is absent on children from the most socio-economically disadvantaged communities, children from difficult home environments and those whose families are socially excluded for a variety of reasons. This section reviews the National Diet and Nutrition Survey: Children aged 1½ to 4½ years (Gregory et al in 1995) the Payne & Belton study (1992), and other relevant studies focusing on preschool children.

1.9.1 National Diet and Nutrition Survey 1.5 to 4.5 years (1995)

The National Diet and Nutrition Survey for children aged 1.5 to 4.5 years was published in 1995 by the Office of Population Censuses and Surveys (now the Office for National Statistics) and the Medical Research Council (MRC) Human Nutrition Unit. In total 1,675 children took part in the survey. This research included a parental questionnaire providing details about the parents, the household and general information about the child's dietary habits; a four day weighed intake record of all food and drink; and a questionnaire on the use of dietary supplements and prescribed medication. Research found that fruit and vegetable intakes were limited in terms of variety and quantity. Baked beans were identified as being the most popular ‘vegetable’, consumed by just over half of the children surveyed. Green leafy vegetables were consumed by approximately 40 % of children, and salad vegetables by less than one quarter. Peas and carrots were the only vegetables eaten by more than 50 % of children. The most popular fruit was identified as apple, which was consumed by half of the children surveyed, followed by pears and bananas. Only 25 % of children ate citrus fruits (Gregory et al, 1995).

Children living in areas of low socio-economic status had significantly lower intakes of micronutrients than other areas. Intakes of Vitamin A and Vitamin D were found to be very low; the main source of Vitamin D was fortified breakfast cereals and the main sources of Vitamin A were milk, vegetables and meat products. Participating children were also found to have low intakes of Vitamin C. Iron intake, calculated from analysis of weighed food intake over four days, was below the lower reference nutrient intake (LRNI) in almost one quarter of children aged 1½ to 2½ years, and 16 % (one sixth) of children aged 2½ to 4½ years. The main sources of dietary iron were identified as fortified breakfast cereals and vegetables and iron supplements made up 2 % of the overall intake of iron. One in twelve children aged 2½ to 4½ years was identified as anaemic, which was attributed to low meat and green leafy vegetable intake, low Vitamin C intake and high intakes of tannins from tea (Gregory et al, 1995). NME sugars made up 19 % of food energy, 9 % over the recommended amount. The main sources of NME sugars were identified as soft drinks and confectionery, and the quantities consumed increased with age to a mean of approximately 250 g per week for children aged 3½ to 4½ years.

1.9.2 Payne and Belton (1992)

A study by Payne and Belton (1992) analysed dietary intake of 153 pre-school children aged 2 to five years in the city of Edinburgh between May 1988 and April 1990. Data was collected using a seven day weighed dietary intake, which was then analysed using COMPEAT dietary analysis software, and 54 of the participating children were reassessed following a period of 12 months. This study predominantly involved parents from higher socio-economic groups with 81 % of mothers and 57 % of fathers coming from groups I, II or IIIN; 'Professional', 'Intermediate' or 'Non manual skilled' Socio-Economic groups; 25 % fathers and 8 % of mothers from the 'Manual skilled' Socio-Economic group (group IIIM), and 17 % of fathers and 11% of mothers from the groups IV and V; 'Semi-skilled' or 'unemployed'.

The findings from the Payne and Belton study (1992) were similar to national findings of Gregory et al (1995). Daily energy intake (kcal) for boys and girls was slightly less than the recommended intake for one to three year olds, with intakes of 1,045 and 1,071 respectively at 2 years and 1,132 and 1,191 respectively at 3 years of age. The % energy from carbohydrate (51 to 53 % across all ages and genders) and % energy from fat intake (34 to 36 % across all ages and genders) were in line with carbohydrate and overall fat recommendations for children (50 % and 35 % overall energy respectively). Starch intake ranged from 9 % to 34 % of overall energy intake; however the majority of sources of starch were from predominantly refined foods such as white bread, cereals, crisps and pasta. Saturated fat intake was higher than the recommended intake (14 to 16 % across all ages and genders) and sugar intake was also high (29 to 31 % of energy intake across all ages and genders). Main sources of sugar were Ribena (20 %), fruit juice (18 %) yoghurt, squash, chocolate, fruit and sweets. It should be noted that the 'total sugar' in this study includes added sugar, honey, and fruit sugar due to the capacity of the dietary analysis program used.

Vitamin and mineral intake varied considerably. Results showed that half of the children consuming more that the recommended nutrient intake of Vitamin A and C, although some of the children had very low levels of these vitamins. Vitamin A intake was from sources such as liver, full fat milk, carrots, soup and cheese and predominant sources of Vitamin C were fruit juice and Ribena. Some children's intake of Vitamin C was excessive due to the amount of juice consumed. Some children had very low intakes of iron and zinc. However, calcium was found to be adequate, with many children consuming in excess of the recommended nutrient intake. Fortified breakfast cereals were a major source of iron. There was also correlation between intakes of all nutrients found in milk including calcium and Vitamin A. The longitudinal data showed similar findings, indicating that dietary intake did not change over time. Research found that children deficient in one nutrient were likely to be deficient in a range of nutrients. None of the children who were of concern were taking a supplement and only 25% of children were given vitamin supplements overall (Payne and Belton, 1992).

1.9.3 The Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC)

The ALSPAC study has collected on dietary intake at various stages (Cowin et al, 2000; Golding et al, 2001; Northstone et al, 2002; Ness, 2004). Food frequency questionnaires were used to assess dietary intake of children at both 18 months (between June and December 1992) and again at 43 months (between January and July 1996). Mothers and/or carers were asked to record the dietary intake of their child for 3 days (one weekend day and two week days). The diet diaries were analysed using Diet In Data Out

(DIDO) software, developed by the MRC Human Nutrition Research Unit in Cambridge. Between 18 months and 43 months a marked decrease in certain foods associated with a post weaning diet was observed. This included foods such as baby foods, drinks and whole milk (reduced by 119 g per day), which may have accounted for the reduction in calcium intake. Consumption of carbohydrate foods increased significantly increased, such as potato products, bread and breakfast cereals. In total, 15.4 % of children ate no red meat during the 3-day period, and 6.1 % ate no meat of any type. The low red meat consumption may have been due to the media response just prior to the collection of data to cases of bovine spongiform encephalopathy (BSE), which is associated with consumption of beef. This may account for the low intakes of iron and zinc, both of which were lower than the RNI.

By the age of 43 months, the intake of energy from fat was close to the recommended intake, although saturated fat intake, was higher than the recommended intake, and there was a considerable increase in NME sugar consumption between 18 months and 43 months, to more than the recommended intake, mainly due to an increase in consumption of sweet foods and sugar confectionery. A decrease was reported in the intake of vegetables between the two studies. At 43 months, children had an average intake of 40 g of vegetables and 69 g of fruit, which was higher than the 32 g of vegetables and 50 g of fruit reported in the NDNS (1995) for the same age group. Findings also suggested that 17% of children ate no vegetables other than potatoes and baked beans, 17.4 % ate no fruit, one quarter of children ate less than 50g of fruit and vegetables per day and 46 % ate none of either. Intakes of all nutrients were higher than those identified in the NDNS (1995), which may be due to a difference in data collection methods rather than differences in intake.

1.9.4 The Scottish Health Survey (2009)

According to the 2009 Scottish Health Survey (Corbett et al, 2010), women and girls had slightly increased their fruit and vegetable consumption (from 3.2 mean portions per day in 2003 to 3.4 in 2009 for women, and from 2.6 in 2003 to 2.8 in 2009 for girls aged five to 15 years), but there has been no significant change for men (3.0 mean portions per day in 2003 to 3.1 in 2009) or boys over the same time period (2.6 mean portions per day in both years). Only 25 % of boys and 31 % of girls aged 2 to 3 years in Scotland ate fresh fruit and vegetables more than once a day (Corbett et al, 2010).

1.9.5 Dietary Survey among Children in Scotland (2010)

The aim of the Dietary Survey among children in Scotland (2010) was to identify intake of NME sugar and saturated fat in children aged 3 to 16 years in Scotland (Masson et al, 2012). Intake was determined using Food Frequency Questionnaires. This research found a decrease in NME sugar from 17.4 % to 15.6 % from 2006 to 2010, although mean intake remained higher than the recommended intake. Intake of NME sugars was mostly from non-diet soft drinks, confectionery, biscuits, cakes, pastries, yoghurts and juice. Intakes increased in lower socio-economic groups, with intakes of 15.2 % in the least deprived areas to 16.7 % in the most deprived areas. Mean intake of saturated fat was slightly greater than the recommended intake (13.2 %). Intake of fat was not impacted by socio-economic status. As level of deprivation decreased, intakes of fruit and vegetables increased and consumption of non-diet soft drinks decreased (Masson et al, 2012).

1.9.6 Other research

Diet diary based research by Cockroft et al (2005) aimed to identify the amount of fruit and vegetables consumed daily by pre-school children in the Bradford area. Results from this research found that children consumed less than the recommended intake of fruit and vegetables, with 14 % of children consuming no fruit and vegetables at all on a daily basis. Vegetable intake was particularly low with 39 % of the sample group consuming no vegetables at the time of the research, and only 16 % of the children surveyed were consuming fruit and vegetables up to 5 times a day. Research by De La Hunty et al in 2000; 'What British children are eating and drinking at age 12 – 18 months' also provided a clear indication of the current intakes of children in the preschool setting. This research consisted of postal questionnaires to mothers who had participated in the 1995 National Survey of Infant Feeding, and included a cohort of 5,069 children with an average age of 14 months. This study found that bread and cereals were consumed frequently; 50 % of children ate raw fruit, 51 % consumed cooked vegetables, 34 % ate meat and 76 % consumed cow's milk daily. Consumption of carbonated and sweetened drinks was common. Furthermore, research by the Department of Health found that less than 4 % of 4 to 6 year olds eat the recommended 5 portions of fruit and vegetables a day (De La Hunty et al, 2000).

1.9.7 Summary of findings

Findings from the above surveys indicate that in general, the diet of children and adults in the UK is too high in fats, salt and sugar, and too low in foods rich in fibre and fluid, such as whole grains, fruits and vegetables. Increased consumption of "empty calories" such as sugary drinks and confectionary, alongside increased consumption of fast food, snacks high in fat and ready meals in conjunction with a decrease in physical activity have contributed to the obesity epidemic seen in the UK today. With regard to actual food items consumed, these studies have identified the most popular foods for preschool children as milk, biscuits, white bread, non-diet soft drinks, savoury snacks, potatoes, chocolate and chips. There is concern that these eating habits continue into childhood, adolescence and eventually adulthood. Gregory et al (2000) found that children from 4 to 19 years consumed an average of 16.4 % energy intake in the form of non-milk extrinsic (NME) sugars, such as sweets, soft drinks and chocolate confectionery. A diet consisting of low intake of fish, red meat, pulse, fruit and vegetable consumption, and high levels of tea consumption may be the cause of the micronutrient deficiency in children (Gregory et al, 2000).

Research by Cockroft et al (2004) identified a great parental influence in the consumption of food products, including fruit and vegetable intake, and studies have identified similarities between parent and child intakes of fruit and vegetables (Fisher et al, 2002 as cited in Cooke et al, 2003). In order to combat the health issues within society today it is important to develop initiatives that aim to introduce a wider range of foods to the diet, and this can be successfully implemented at all stages of dietary intervention from weaning. However, there are many factors identified by the Scottish Diet Action Plan (1996) that may prevent families from eating a healthy balanced diet such as access, affordability, availability, knowledge and social issues. These key barriers need to be addressed in order to encourage a healthier lifestyle within the home. Interventions are clearly required that focus on improving dietary intake in the home and the education and social environments of pre-school children, particularly in areas of low socio-economic status, to increase consumption of fruit and vegetables, reduce the amount of saturated fat and sugar consumed. Tedstone et al (1998) identified priorities for dietary change in pre-school children in order to achieve Government recommendations, including increased consumption of iron rich foods, increased consumption of fruit and vegetables (both variety and quantity), and an increase in consumption of starchy foods and foods rich in

NSP. A decreased consumption of sugary foods and drinks, salty foods and tea was also recommended for optimum health.

1.10 Interventions to identify methods of dietary improvement in preschool children

Enforcing healthy eating habits in infants and young children is essential for growth, development and individual food preferences throughout life (Higginson, 2001). A review by Tedstone et al (1998) of the effectiveness of interventions to promote healthy eating in pre-school children aged one to five years, found that pre-school and day care centres were likely to be appropriate settings for interventions, and that parental involvement should be facilitated to enhance the effectiveness of interventions. Acheson (1998) concluded that 'pre-school education or day care may be especially effective in improving the achievement and health of the most disadvantaged children'. The following section is a review of a range of intervention studies carried out that used different methodologies to improve dietary knowledge and intake of parents and children within the nursery setting. Types of interventions include educational activities for parents, children and classroom workers, settings-based interventions (community, nursery, school, and health centre), behavioural change interventions, provision of healthy foods, dietary counselling and management. Markers for measuring the impact of health interventions include changes in dietary and nutrient intake, changes in variety of foods consumed, improved knowledge and attitude, and biochemical markers.

There was consensus amongst parents in the Hesketh et al study (2005) that obesity prevention strategies needed to begin early in a child's life, long before they reached the school setting. Parents recognized that behaviours are shaped early in life and were largely already entrenched by the time children reached school age. Parents strongly believed they should play an important role in any obesity prevention strategies. They did not believe that behavioural change could be achieved by targeting only children, suggesting that strategies should also target parents. Parents also recognized the important role of both themselves and teachers to model healthy lifestyles rather than merely to encourage children to consume healthier diets and increase physical activity (Hesketh et al, 2005). However, interventions do not always reach the parents that are most in need of education and assistance; Hesketh et al (2005) identified an inability to access parents from culturally diverse and lower socio-economic groups, despite access to their children. Despite many alternative attempts, it was very difficult to engage either groups or individual parents from socially excluded populations. Lower literacy rates and lower rates of school involvement amongst parents from these groups are likely to have contributed to this.

Some methods, such as adult modelling of food behaviours, positive reinforcement, and use of group influence and sensory experience of foods, have been tested and are used in practice in many day early years facilities. Health promotion now recognizes the need to consult and engage people within the context of their community, and increasingly programs aimed at improving the health of children are being designed in partnership with children and parents (Potvin et al, 2003). There is an absence of published research that has examined the views of children and their parents on how effective health promoting and sustainable obesity prevention programmes should be developed (Hesketh et al, 2005). There are also several major gaps in the research literature, including an absence of studies on preschool children. Many of the intervention studies are also hindered by an absence of theoretical foundation, a small sample size, absence of longitudinal data, and an absence of key information, such as the age and socio-economic status of the target audience. A systematic review of types of healthy eating interventions in pre-schools by Mikkelson et al (2014) concluded that there is a "scarcity of properly designed healthy eating interventions using clear indicators and verifiable outcomes". Duration of interventions has been short term, as have their evaluations (Deakin University, 2005).

1.10.1 Interventions involving parents

Successful interventions targeted at parents have the additional benefit of influencing food related cultural and social norms in the home (Higginson, 2001). Parental behaviour can impact greatly on children's consumption of fruit and vegetables (Cooke et al, 2004) as it influences what children learn, how children respond to the external environment, and what children expect of themselves (Shonkoff and Phillips, 2000). Longbottom et al (2002) found a significant correlation between parental and child intakes of foods, including snack foods. A study by Cooke et al (2004), with of a sample of 564 parents and key carers of preschool children in London, found that over one third of children failed to eat any fruit and vegetables on a daily basis, in spite of media campaigns and public health campaigns carrying the 5-a-day message. This study found that indicators of vegetable consumption included maternal education in addition to a child's age and gender. This study also found that parental consumption of fruit and vegetables was a highly significant predictor of fruit and vegetable consumption in preschool children.

Research by Tedstone et al (1998) found that one to one diet counselling that was 'needs focused' was successful at bringing about improvements in UK mothers. In a study of 60 children aged 3 to 4 years, Essa et al (1988) demonstrated improvement in nutrition knowledge both within the nursery setting and in the home following a 10 week educational intervention, with significantly increased impact when there was additional parental involvement at home. However, a study by Lee et al (1984) that observed two different methods of 8-week nutritional education interventions to investigate the ability of preschool children to learn the basic conceptions of nutrition identified a more significant increased knowledge in the children who were taught in the classroom setting than those taught at home, but an overall increase in knowledge in both groups. However there was also evidence of improved food recognition in the control group who received no intervention. There is also no evidence that this improved knowledge led to an improvement in dietary intake in either the Essa et al (1988) or the Lee et al (1984) studies, and both are constrained by the small numbers of participants in each group. Koblinsky et al (1992) carried out an evaluation of a parent education programme implemented by nutritionists that worked with low income mothers of preschool children in the US, with the aim to change the overall balance of the children's diet and of the mothers nutrition related behaviour. An improvement in the diet of children, and an improvement in the organisation of food related tasks such as meal planning and eating regular meals were observed. However, there was no control group, and there was also no follow up research to identify longitudinal success. A randomised controlled trial by Céspedes et al (2013), which focused on interactive classroom activities with parental involvement for 1,216 children from low income and middle-income families found a significant increase in knowledge and attitude in both children and their parents, although the change was more significant in the children.

1.10.2 Educational interventions

It is widely accepted that educational interventions are the first step towards behaviour change. Two reviews have identified the following features of an effective school based intervention: Nutrition education interventions are more likely to be effective when they employ educational strategies that are directly relevant to a particular behaviour (e.g. diet or physical activity) and are derived from appropriate theory and research; interventions need adequate time and intensity to be effective; family involvement enhances the effectiveness of programmes for younger children; incorporation of a self-evaluation or self-assessment and feedback is effective in interventions for older children; effective nutrition education includes consideration of the whole school environment and community; interventions in the larger community can enhance school nutrition education; the most effective interventions focus on diet alone or diet and physical activity (Contento 1995; Roe et al. 1997).

A number of studies have demonstrated an increase in knowledge by using a range of educational interventions. In 1985, Gorelick and Clark ran 6-week trial interventions to assess the effectiveness of a nutrition education programme (the California state University nutrition education kit) for 187 randomly selected preschool children from a range of socio-economic backgrounds. A significant increase in knowledge of nutrition was observed in the intervention group at all ages (Gorelick & Clark, 1985). A more recent US study by Cason (2001), which used the multiple intelligence theory as the basis of a 24 week nutrition curriculum designed to improve knowledge and acceptance of healthy food items in 6102 children aged 4 years, found that there was significant improvement in food identification and recognition, willingness to taste foods, and an increased frequency in consumption of healthier food items. However, there was no control group used (Mikkelson et al, 2014). Hu et al (2009) also demonstrated success in knowledge, behaviour and attitude improvement with 2,102 children aged 4 to 6 years in Chine using a nutritional educational program over a 10 month period which included an illustrated book and other visual tools. However, there was no theoretical foundation applied to the educational intervention (Mikkelson et al, 2014).

A study in 1990 by Lawatsch investigated the impact of two teaching strategies (benefit appeal and threat appeal) on the knowledge of and attitudes and food behaviour with emphasis on vegetables in 103 four-year old children in four New Jersey preschool centres. Using traditional stories as a form of education, the study showed improved attitude, increased knowledge and increased selection of vegetables consumed by the target group, with the benefit approach proving more effective than the threat approach (Lawatsch, 1990). However, not all interventions have shown significant improvement. A 1993 educational intervention that carried out educational and food based activities with more than preschool 1,000 children from low-income families led to no significant change in knowledge, although there was some improvement seen in attitude and behaviour, in terms of foods accepted and rejected (Byrd-Bredbenner et al, 1993).

The above results indicate that development of health promotion interventions and educational and training resources could be beneficial for health professionals working in the field of preschool health and nutrition, and that involvement of parents and carers may be beneficial when promoting key health messages aimed at decreasing rates of obesity, such as the consumption of more fruit and vegetables. Success of an educational intervention may also be dependent on the level, relevance in terms of age appropriateness and design of the resource used and the teacher's methods; Tedstone et al (1998) found that traditional, video or computer-based teaching methods were successful at increasing nutrition knowledge and the effectiveness was enhanced by the inclusion of parents, and Peterson et al (1984) saw improvement in knowledge with the use of nutrition video programmes. More modern technology such as the use of apps and social media may be beneficial tools in health promotion in the educational setting.

Although many studies have identified an improved knowledge and understanding of nutrition, there was in many instances no impact observed on food choices. Gorelick and Clark (1985) found that education interventions to improve food choice were less effective on children aged 3 to 5 with than older children. Also, although the majority of these studies demonstrated success at the time of the intervention, there is little evidence of a positive longitudinal effect on level of knowledge or on food choices. With the exception of Nemet et al (2013) who conducted a 1-year follow up, there were no follow up studies to assess the long-term impact of the educational interventions discussed above. Further research is required to validate the positive effects of each of the teaching methods used in a wider population setting, and impact over time.

Success may also depend on the theoretical foundation that the intervention is based on There are a number of theoretical foundations for educational interventions that are now a key element in the design of studies. For example, the Céspedes et al (2013) study was based on Social Cognitive theory, and the Cason study (2001) was based on the Multiple Intelligence theory. However, a number of educational interventions, such as Hu et al (2009) and Piziak et al (2009) are not clearly based on a theoretical foundation. Educational interventions should have some knowledge of health behavioural or educational theories that explains the process behind the success or failure of the implementation of their educational programs (Mikkelson et al, 2014). Roe et al (1997) found that characteristics of a successful intervention had clear goals based on theories of behavioural change, rather than relying on the provision of information alone. The general literature on behaviour change suggests that in most instances changes are unlikely to be sustained. Research by Tedstone et al (1998) indicated that the use of rewards to encourage consumption of foods was not successful once the reward had been removed. Measuring behaviour change soon after completion of an intervention is unlikely to reflect the longer-term impacts of the intervention, thus early outcomes of these interventions should be viewed with caution (Deakin University, 2005).

1.10.3 Provision of healthy food items

Both England and Scotland have a free fruit scheme; in England children aged four to six years who attend a fully state funded infant, primary or special school are entitled to receive a free piece of fruit or vegetable each school day (National Health Service, 2015). In Scotland, children in the first two years of school (aged five and six years) receive 3 free pieces of fruit per week. Overall, research carried out in 2005 with key stakeholders, local authority members and school staff indicated that the initiative is a success. However, a minority of local authority and school respondents felt that the initiative was disruptive for schools; that the fruit supplied to schools was not always of the highest quality; and the storage facilities within schools were not always adequate (Scottish Government, 2005).

There are some reports that distribution is either poor or does not occur at all in some areas, due to a tightening on UK Government spending. Research by Reinearts et al (2007) in the Netherlands compared two methods of intervention to determine which had the greatest impact on fruit and vegetable consumption in six primary schools. The first intervention was a free fruit and vegetable distribution scheme, and the 2nd intervention was based around education through parental involvement and classroom curriculum. Results indicated that both methods of intervention were successful, causing an increase in portions of fruit and vegetables of 0.2 per day. The distribution scheme was more successful overall, especially with regard to vegetable consumption.

1.11 The Scottish Government and a time for change

As a result of the financial and health implications of obesity and diet related medical conditions, many countries have introduced Public Health policy aimed at reducing the rates of overweight and obesity, and increasing awareness of healthy life choices such as diet and physical activity. Historically, the Scottish diet has been considered poor for several decades. Since the 'Black Report' in early 1980s, the increasing gap in British health and life expectancy has been well documented, highlighting the differences experienced by people living in poverty and those living in prosperity. Scotland was one of the first countries to identify need for interventions to improve diet related health conditions and to produce national policy for dietary improvement.

1.11.1 Policy to improve health

In 1992 the policy statement *Scotland's Health: a Challenge to Us All* explored Scotland's poor health record and concluded that extensive action was needed. The following year, the *"James Report",* officially known as *"Scotland's Health: A Challenge To Us All: the Scottish Diet"* (1993) highlighted the need for a concerted action plan on the Scottish Diet. The James Report identified key issues with the diet of the population, including an excessive consumption of fats, and in particular saturated and Trans fatty acids, excessive consumption of refined sugars and salt and low intakes of antioxidants, vitamins, minerals and fibre. The report stated that the intake of fruit and vegetables was approximately 180 g per day, less than half of the World Health Organisation recommended amount of 400 g per day. Research also indicated an increase in various diet related illnesses such as obesity, diabetes type II, coronary heart disease and various cancers.

Three years later, in 1996, *"Eating for Health: A Diet Action Plan for Scotland"* (also known as the Scottish Diet Action Plan) was published by the Scottish Office. This document contained over seventy action points and set several dietary targets that were to be achieved over a 10-year period to improve the Scottish diet. One of the central dietary targets was increasing the intake of fruit and vegetables to the recommended 400g per day. Over the next ten years, a number of policy documents with implications for food and health were developed. These included the 1998 "*Food Standards Agency – A Force for Change",* which outlined plans and purpose for establishment of the Food Standards Agency (FSA) and FSA Scotland. *"Towards a Healthier Scotland: A White Paper on Health"* was released by the Scottish Executive in 1999. This document set the framework for public health and health improvement policy in Scotland, recognizing that a reduction in health inequalities was core to health improvement in Scotland. Also includes was the framework for initiatives aimed at the prevention and early detection of cancer and coronary heart disease.

In 2000, "*Our National Health – A plan for action, a plan for change*" (Scottish Executive, 2000) was released with the purpose of improving health and reducing health inequalities in Scotland by establishing a Public Health Institute and improving and modernising the National Health Service (NHS). Focus was aimed toward improving health, reducing poverty and increasing educational attainment, particularly in the most disadvantaged communities of Scotland. The Health Promoting Schools initiative was outlined, with emphasis on provision for healthy foods in schools and nurseries. Investment in the Scottish Community Diet Project was announced to support local community based projects. The policy promised investment in Scotland's Health at Work Scheme (SHAW), which enabled more employers to develop health promotion initiatives in the workplace. The policy also included the introduction of the Physical Activity Task Force.

In 2003 the Scottish Executive released a document called "*Improving Health in Scotland – The Challenge"*, which was a review of the impact of the 1993 James report, and a strategic framework for health improvement. This document set a health vision for 2020 with a new framework for health improvement and seven special focus programmes, including diet and healthy eating. In 2004, "*Eating for Health: Meeting the Challenge"*, was developed by the Scottish Executive through dialogue and discussion with partner organisations that built upon the key actions outlines in "*Improving Health in Scotland – the Challenge"* to guide national policies and actions as well as local food and health action plans. Community food projects were promoted as one of the solutions to addressing food poverty and health inequalities among a range of measures.

In 2006, Health Scotland released the document "*Review of the Scottish Diet Action Plan: Progress and Impacts 1996 – 2005*" which reviewed the effectiveness and appropriateness of the Scottish Diet Action Plan following nine years of implementation (1995-2005). The review concluded that although some advances in thinking and practice have been made and some initiatives have been aspiring as well as effective, the total shift required and sought by the Scottish Diet Action Plan in 1995 had not been realised. This document indicated that consumption of fruit and vegetables, particularly in children, and in areas of low socio-economic status, was still much lower than the optimal recommendation. In addition, the Scottish diet was still high in NME sugar and saturated fat, low in whole grains and unsaturated fats, particularly in areas of low socio-economic status (Health Scotland, 2006; Food Standards Agency, 2007).

In 2007, the Scottish Government outlined a more streamlined Government, by developing five national Strategic Objectives that all new work and policy directives should work toward: Wealthier and Fairer, Smarter, Greener, Safer and Stronger, and Healthier. Within this National Performance Framework, which was updated in 2011, the Scottish Government has developed a set of 51 'national indicators' to track progress towards outcomes, which include explicit targets (Scottish Government, 2011). All of the inequality focussed policies and all key policy documents developed since 2007 now reference the National Strategic Outcomes.

1.11.2 Improving health in children

For more than 15 years, policy has been in place to improve the nutritional health of preschool aged children in Scotland. '*Eating for the early Years'* (Forth Valley, 1997) and '*Eating well for the under-fives in childcare'* (Caroline Walker Trust, 1998), which includes a training pack and a programme for menu planning, have both provided guidelines for nutritional intake in children in the early years. In 2003 the Adventures in Foodland activity pack was issued to all preschool educational settings in Scotland. In 2003, "*Hungry for Success – A whole school approach to school meals in Scotland*" was developed as a response to the poor quality of school meals in Scotland and the rising obesity levels in children (Scottish Executive, 2003). This document outlined the nutritional requirements of children at school age and gave recommendations for applying these recommendations, and monitoring and evaluating schools to ensure that the guidelines were adhered to. This report also recommended a free fruit provision for all Primary 1 and Primary 2 children in local authority managed schools. This initiative was implemented across Scotland in 2003; the 2005 SEED School Meal census found that this initiative had been successfully implemented, with almost 100 % of schools providing free fruit (Scottish Executive, 2005).

More recently, the 2006 document '*Nutritional guidance for early years: food choices for children aged 1-5 years in early education and childcare setting*', provided healthy eating guidelines for institutes providing care to preschool aged children. The guidance set out the nutritional requirements for children aged 1 to 5 years and provided advice on how to meet these requirements. These guidelines have been issued to providers of childcare for children aged 1 to 5 years and apply to a wide range of providers across Scotland, including local authority nurseries, private nurseries, playgroups, child minders, toddler groups, crèches, school meal services and family centres.

The aim of this document was to help to work towards the quality of service described in the document "*National Care Standards - Early Education and Childcare up to the Age of 16; Standard 3 Health and Wellbeing"* which states that *"Each child or young person will be nurtured by staff who will promote his or her general wellbeing, health, nutrition and safety".* It is especially relevant to National Care Standards 3.3 "*Children and young people have opportunities to learn about healthy lifestyles and relationships, hygiene,* *diet and personal safety"* and National Care Standard 3.4 "*Children and young people have access to a well-balanced and healthy diet (where food is provided) - which takes account of ethnic, cultural and dietary requirements, including food allergies".* The document provides guidance on menu planning, oral and dental health, physical activity, snacks and drinks, and how to encourage the development of good eating habits. Also included in the document is advice on partnership working, working with parents and guardians, evaluating and monitoring and staff training.

In 2007 The National Performance Framework was developed, and contains 'national indicators' that are relevant to dietary health in all children. These include *"Working with children and parents to improve access to affordable fruit and vegetables locally"* (National Outcome 5); "*Improving access to and uptake of healthy food choices by working with community food co-ops and cooking skills programmes*" (National Outcome 6); "*Focussing on areas where accessing healthy food choices are most challenging*" (National Outcome 7); and "*Using community development approaches to tackling food and health inequalities wherever possible*" (National Outcome 11). These outcomes aim to reduce the gap of inequality and improve health of children of all ages from areas of lower Socio-Economic Status in Scotland (Scottish Government, 2007).

Also in 2007, the document *"Better Health Better Care: Action Plan"* set out the Scottish Government's programme to deliver a healthier Scotland. This document placed a strong emphasis on 'the best possible start' in life; it gave commitments to develop actions to promote nutrition within a new Food and Health Delivery Plan, to 'target' NHS Boards to improve breastfeeding rates and to appoint an Infant Nutrition Co-ordinator at national level (Scottish Government, 2007).

The Schools (Health Promotion and Nutrition) (Scotland) Act (2007) built on the work of health promoting schools and Hungry for Success, which aims to improve the health of children at primary school level onwards in Scotland. This Act places health promotion at the heart of school activities, ensures that food and drink served in schools meets nutritional requirements specified by the Scottish Government, ensures local authorities promote the uptake and benefits of school meals and, in particular, free school meals, reduces the stigma associated with free school meals by requiring local authorities to protect the identity of those eligible, and gives local authorities the power to provide pupils with low cost or free of charge healthy snacks and drinks (Scottish Government, 2008). "*The Nutritional Requirements for Food and Drink in Schools (Scotland) Regulations 2008)"* contain updated information on nutrient standards first outlined in

"*Hungry for Success – A whole school approach to school meals in Scotland*" (2003). This document contains guidance on the proportion of nutrients that pupils should receive from an average days' school lunch, and gives guidance on the types of foods and drinks that should and should not be provided, the frequency at which they should be offered. This document also contains guidance on the standards of foods and drinks that can and cannot be served out with the school lunch, such as those served at breakfast clubs, tuck shops, vending machines, as mid-morning snacks, in community cafes and after school clubs. However, the regulations do not apply to packed lunches or foods purchased outside the premises and brought to school for consumption.

The 2008 document *"Healthy Eating in Schools: A guide to implementing the nutritional requirements for food and drink in schools (Scotland) regulations 2008"* has been produced to assist schools with the implementation of these standards and has been distributed to all school in Scotland. Although this Act is for school aged children only, it is an important step forward in improving the nutritional standards of foods permitted in schools. Guidance for nurseries and preschool centres is provided in the above-mentioned "*Nutritional Guidance for the Early Years*" document, which was published in 2006.

The 2008 paper *"Healthy Eating, Active Living Action Plan: an action plan to improve diet, increase physical activity and tackle obesity 2008-2011"* outlined how the Scottish Government would use budgetary resources to improve the nation's diet, encourage greater physical activity and begin to establish a base for tackling obesity through both targeted interventions and by supporting the Scottish people to achieve and maintain a healthy weight. Within the action plan was a commitment to improving nutrition in women of childbearing age and young children living in areas of deprivation. Following on from this, a Chief Executives letter (CEL36) was issued to Chief Executives of Health Boards committing funding to support a range of activities to support these priorities (Scottish Government, 2008).

HEAT targets, originally developed in 2008 and updated in 2011, are NHS focussed initiatives spanning across a range of topic areas, and delivered in partnership with the local authority. The acronym stands for "Health improvement for the people of Scotland; Efficiency and Governance improvements; Access to services, and Treatment appropriate to individuals". The HEAT target aimed at improving child health was the introduction of "Child Healthy Weight Interventions". This target included a requirement to focus at least 40% of interventions on top two most deprived SIMD quintiles (Scottish Health Survey, 2010). NHS Scotland aim to achieve 14,910 completed child healthy weight interventions between April 2011 and March 2014. For the year ending March 2012, the number of completed interventions was 5,052, 679 of which occurred in NHS Lothian.

In 2008, the Scottish Executive document "*Equally Well: Report of the Ministerial Task Force on Health Inequalities*" outlined the priorities identified where action is most needed. This included children's very early years, mental illness, the "big killer" diseases (cardiovascular disease and cancer) and drug and alcohol related issues such as violence. This document highlighted the critical importance of children's circumstances in the earliest years of life to future health inequalities; and called for action 'to end the cycle of health inequalities which passes from parent to child'. The document included the following recommendations: The Government should lead the development of holistic support services for families with very young children at risk of poor health and other poor outcomes (Recommendation 7); There should be a range of services that identify need and provide support to the most vulnerable children and families (Recommendation 8); Physical environments that promote active lifestyles for young children, including opportunities for play, physical activity and healthy eating, should be a priority for local authorities and other public services (Recommendation 14) (Scottish Government, 2010).

In December 2008, The Early Years Framework was launched, signifying the Scottish Government and Convention of Scottish Local Authorities' (CoSLA) commitment to the earliest years of life being crucial to a child's development. The framework signalled local and national Government's joint commitment to reduce inequalities in health, education and employment opportunities through prevention and early intervention and to give every child in Scotland the best start in life. The framework covered the interests of children from pre-conception to the age of 8 years and set out a list of short term, medium term and long-term priorities for action. This framework focuses on reducing poverty and inequality (Scottish Government, 2008).

The 2009 Policy *"Recipe for Success - Scotland's National Food and Drink Policy"* set out the next steps of "*Scotland's National Food and Drink Policy"*. In partnership with food outlets, retailers, NHS, Scotland Food and Drink, Enterprise Agencies, local authorities and communities, the policy requires delivery of key targets including ensuring that people make healthy and sustainable choices, making food both available and affordable to all and ensuring that people understand more about the food they eat.

In 2010 the Scottish Government and CoSLA launched a route-map called "*Preventing Overweight and Obesity in Scotland: a route-map towards healthy weight"*. This route-map was aimed primarily at decision makers in central and local Government. It included high-level actions aimed at '*reducing the rate of increase in the proportion of children with their Body Mass Index out with a healthy range by 2018*' and identified four key areas in which action is likely to have the greatest effect: reducing demand for and consumption of excessive amounts of high calorie foods and drinks; increasing opportunities for uptake of walking, cycling and other physical activity; establishing life-long healthy habits in children; and increasing the responsibility of organisations for the health and wellbeing of their employees (Scottish Government, 2010).

In January 2011 the Scottish Government released the framework *"Improving Maternal and Infant Nutrition: A Framework for Action"* to ensure that all children have the best possible start to life, are ready to succeed and live longer, healthier lives. To help achieve this the Scottish Government has also developed the "*Maternal and Infant Nutrition Framework for Action*" which is aimed at a wide variety of organisations with a role in improving maternal and infant nutrition in Scotland. The Framework outlines actions to improve nutritional intake from pre-conception, through pregnancy and early years nutrition up to the age of 3 (Scottish Government, 2011).

1.12 Edinburgh Community Food Initiative

Edinburgh Community Food Initiative (ECFI), which rebranded in 2009 as Edinburgh Community Food (ECF), is a citywide, community-based charity organisation that focuses on working with communities, organisations and individuals to reduce health inequalities relating to diet and create opportunities for positive behavioural and dietary change. Taking health inequalities as its starting point, ECFI (ECF) has operated a number of projects in a range of settings since it first opened in the 1990's that are aimed at enabling people to better understand the concept of and to overcome barriers to healthy eating.

1.12.1 Edinburgh City and SIMD ranking

There has been a decline in the number of data zones in Edinburgh that fall into the 15% most deprived areas in Scotland. According to the Scottish Index of Multiple Deprivation (SIMD) 2012 General Report, multiple deprivation in Scotland has become less concentrated over time. Of the 325 data zones in the 5% most deprived data zones in Scotland, 19 (5.8%) were found in Edinburgh City in 2012, compared to 22 (6.8%) in 2009, 27 (8.3%) in 2006 and 25 (7.7%) in 2004. In addition, 54 (5.5%) of the 976 data zones in the 15% most deprived data zones in Scotland were found in Edinburgh City, compared to 60 (6.1%) in 2009, 63 (6.5%) in 2006 and 61 (6.3%) in 2004. (Scottish Government, 2012).

1.12.2 Background

ECFI's methods and approaches were based on the principles of promoting equity and social justice, and projects were developed using community development methodologies as defined in 'Health Promotion' (Naidoo and Willis, 2000). Early activities included an examination of the barriers to healthier eating for people living in low-income areas of the city. A survey carried out in 1992, called '¾ of an egg', which had a sample size of 200 single parent families, and found that many women were eating seriously inadequate diets in terms of their nutritional quality. This study, which is available from ECFI, showed that there were a number of external factors that inhibited positive dietary change which were understood to be inter-related, to a varying extent systemic, and largely out with the control of individuals. These factors were characterised in the conclusion of this study as 'the 5 A's': access, availability, affordability, attitude and aptitude.

In more precise terms, the research indicated that a significant proportion of people in low-income situations felt that supermarkets did not provide a service that met their needs, either because supermarkets might be difficult to access physically or that supermarkets did not cater to their shopping needs. Cost savings from supermarkets tended to come largely from bulk buying, which for many people on low incomes was not an easy option. Some highlighted that 'any potential saving from supermarket shopping was swallowed up by spending on unplanned items'; therefore they preferred to avoid temptation and shop elsewhere. People reported that their experience of long-term management of a low-income showed there was little scope for dealing with unforeseen expenditure.

Often the food budget was the only area where there was any flexibility. This led to a feeling of insecurity with regard to the ability to stretch the budget between 'pay days' and tended to inhibit large outlays on food at the beginning of a budgeting period and led to food shopping occurring on a number of occasions throughout the period. The consequent reliance on local shopping facilities with the limit in the variety of affordable healthy choices available, combined with the decline in the transfer of skills and knowledge around food preparation in the population generally, created a matrix of factors that inhibited the ability to make choices towards a healthier diet (www.edinburghcommunityfood.org.uk) .It was in order to address these issues that ECFI developed its ‘Provide & Promote’ methodology.

1.12.3 Provide

From the early 1990’s until 2008, Edinburgh Community Food Initiative assisted community food outlets to set up and manage community based initiatives, which included local volunteer operated food co-operatives, as well as a range of smaller initiatives such as fruit and vegetable stalls. These would typically be located within local community facilities such as neighbourhood or community centres, G.P. surgeries and church halls. ECFI would deliver a comprehensive range of fresh produce at cost price on a ‘sale or return’ basis to most of the groups it supported, as well as offering administrative and developmental support. This allowed co-op managers to experiment with more unusual fruits and vegetables as well as to display an abundant amount of produce, helping to create an attractive display. All of ECFI’s children’s projects also followed this methodology. The provision of fresh produce was central to the wide range of complimentary development activities supported by each of the projects managed by the organisation.

Operating from its warehouse in the Leith area of Edinburgh, ECFI would bulk buy produce from a range of suppliers, including the local fruit and vegetable market as well as a variety of local farmers. The community programme’s basic order form was made up of around 80 different items of fresh produce, which was supplemented by a range of seasonal items throughout the year. By the beginning of 2007, ECFI had a large and wide ranging weekly customer base that included sixteen local community food co-operatives; approximately thirty smaller scale community food access initiatives such as fruit stalls; 106 primary and special needs schools; 45 nursery schools and nursery classes and 12 Children and Family Centres; as well as responding to frequent requests to support local community events and projects.

1.12.4 Promote

The provide and promote philosophy of ECFI believed that providing produce alone would not effectively enable people, particularly those in low-income circumstances, to make positive changes to their dietary habits. Making the produce available to local communities, schools, nurseries and local groups allowed the organisation to address some of the extrinsic barriers to making healthier food choices, but did not allow change to intrinsic barriers. The project complimented food provision work with a team of public health nutritionists whose remit was to developing skills, knowledge and confidence relating to food issues to help community groups and other projects to gain an insight into addressing food issues. Focus was placed on disadvantaged areas and those who are socially excluded such as the elderly, mentally ill and disabled as well as parents of young children and the children themselves. Research indicates that they have these sub groups have the highest rates of diet related illnesses and poor overall diet quality in Scotland (Scottish Executive 2006).

1.12.5 Children's Health Initiatives

Between 1999 and 2007, ECFI was responsible for the operation of three school-based children's health initiatives. In 1999, Snack Attack, a fruit tuck shop scheme, was established. Until March 2007 the scheme operated in all council-sector schools in Edinburgh, delivering the Government funded free fruit to all P1 and P2 children, as well as children eligible for free fruit through free school meal status. In addition, all children from P3 to P7 were able to purchase fruit at the subsidised rate of 10p per piece from the school tuck shop. The Happy Jack project, established in 2004 and funded by Sure Start, currently works with children aged 0-3 and their families in the 12 social work operated child and family centres located in disadvantaged areas of Edinburgh. This project provides free and subsidised fruit to all children that attend the centres as well as offering basic cooking classes to parents, carers and staff.

1.12.6 The Pip Project

In 2004, Edinburgh Community Food Initiative was awarded a three-year funding grant through the Big Lottery Cancer Prevention Fund to develop and implement a healthy eating program aimed at preschool children and their parents, as part of the nationwide push to facilitate parents from areas of low socio-economic status to make a healthier choice, thus reducing the risk of obesity and the associated co-morbidities such as cancer.

The key aim of the Pip Project was to impact positively on children's health and health potential by influencing attitudes and behaviour relating to healthy eating among pre-school children in nursery education, and their families, particularly within recognised priority areas of Edinburgh. The Pip Project aimed to increase the amount of fruit and vegetables consumed by children and their families in disadvantaged areas of Edinburgh, helping them to overcome barriers to healthy eating by:

1. Improving overall diet quality
2. Increasing nutritional knowledge and awareness
3. Improving attitudes towards healthy foods
4. Increasing access to healthier foods
5. Achieving affordability of healthy foods
6. Increasing availability of healthier foods

The project worked with staff, parents and children in council sector nurseries located in priority areas of Edinburgh to achieve these aims through the following interventions:

Free fruit and vegetables for snacks: Each child participating in the project received a portion of fruit or vegetables each day. Each nursery was offered a choice of 20 fruits and vegetables and was able to select the range deemed most appropriate for the children attending their nursery. The aim of this intervention is to increase acceptance of a wider range of fruit and vegetables and to ensure that the children in key priority areas receive some fruit and/or vegetables each day.

Fruit stalls: Each participating nursery was offered the opportunity to set up and maintain a fruit stall where parents could purchase bags with five pieces of fruit for 50p (30 of the 45 nurseries agreed to this intervention). In addition, seasonal soup packs were available for 80p during autumn and winter. The aim of this intervention was to increase household access to low cost, high quality fruit and vegetables on a regular basis.

Activity and support pack: All council sector nurseries in Edinburgh, with the exception of the nurseries in the control group for this research, received the Pip Project Activity Pack. This pack contains a wide range of fruit and vegetable based games, art and craft ideas, recipes, songs and rhymes based on seasonal produce and cultural and religious festivals and holidays. The pack is designed to encourage nursery staff to incorporate fruit and vegetable activities into their forward planning. Each activity complements one or more aspects of the pre-5 curriculum (Scottish Executive, 1999). The key aim for this pack is to improve knowledge and acceptance of a range of fruit and vegetables.

Promotions: Various promotions took place throughout the 3-year intervention. Each month for the duration of the funding there was a health-orientated promotion at each fruit stall, including vouchers for free produce at local co-ops, oral health packs and a range of leaflets on diet and healthy eating. Throughout each academic year, each pip-funded nursery received the promotions ‘fruit faces’ and ‘vegetable men’. Each term there was a seasonal promotion in the 45 funded nurseries and in June 2006 there was an annual promotion available to all pip funded nurseries plus participating nurseries, with the exception of the control nurseries for this research. Apple trees, berry bushes and vegetable patches were also planted in nursery grounds throughout the duration of the project, allowing children to develop a better understanding of the origin of the fruit and vegetables that they are eating. The aim of these promotions was to expose carers, staff and children to a wider range of healthy food items and to increase knowledge of a wider range of health related issues.

Resources: In addition to the Pip Project activity pack, Pip funded nurseries received a range of resources to facilitate the preparation of fruit and vegetables, and also to assist with the education of the children. These resources included a smoothie maker, a hand blender, a pineapple corer, banana slicers and kiwi spoons, books related to fruit and vegetables and cooking equipment in addition to a range wide range of leaflets and recipes to facilitate the work of the nursery staff.

It was decided in 2004 by the projects’ advisory committee that of the 99 council sector nurseries in Edinburgh, 45 nursery classes were eligible for participation, which equated to approximately 2,000 children and their parents. Eligibility was determined by several methods including free school meal percentage (FSM %) of the school attached to the nursery, average free school meal percentage (Av FSM %) of the 3 schools closest to the nursery, and electoral ward score using the Scottish Index for Multiple Deprivation (SIMD), which is a system of categorisation of wards in Scotland according to relative deprivation/affluence of those living within them. The majority of the nurseries selected were located within or close to identified ‘priority’ wards, including Sighthill, Stenhouse, Murryburn, Parkhead and Dalry in the west of the city, Muirhouse, Pilton, Drylaw and Granton in the north, Holyrood and Restalrig in central Edinburgh, Leith, Lorne, Newhaven and Harbour in the east and Craigmillar, Inch/Gilmerton and Kaimes in the south of Edinburgh.

During the design phase of the Pip Project, Edinburgh Community Food Initiative, in conjunction with Queen Margaret University, agreed to support research to determine the project’s effectiveness. Even though funding is given to support interventions such as the Pip Project, there have been very few studies to determine if interventions such as these actually achieve dietary and behavioural change over time, particularly within the preschool age group, and in areas of low socio-economic status. This research was therefore designed to evaluate dietary and behavioural change of children and their carers over the two-year period that the children attended nursery.

Table 1.7: Aims and interventions of the Pip Project:

Aim	*Intervention*
1) Improving overall diet quality	Free fruit and vegetables, fruit stands, provision of resources, quarterly promotions
2) Increasing nutritional knowledge and awareness	Free fruit and vegetables, support pack, provision of resources, regular and quarterly promotions, tree planting, cooking courses for parents
3) Improving attitudes towards healthy foods	Free fruit and vegetables, support pack, provision of resources, regular and quarterly promotions, tree planting, cooking courses for parents
4) Increasing access to healthier foods	Free fruit and vegetables, fruit stands, soup packs, fruit stand promotions
5) Achieving affordability of healthy foods	Fruit stands, soup packs, fruit stand promotions
6) Increasing availability of healthier foods	Free fruit and vegetables, fruit stands, soup packs, fruit stand promotions

2 Aims, objectives and research questions

Although a number of interventions have been shown to successfully increase the nutritional knowledge of preschool children and their parents, the effect on actual food choice and consumption has been harder to demonstrate, particularly from those who reside in areas of lower socio-economic status. At the time of this research there was minimal data relating to the dietary intake of preschool children, and particularly those from SIMD identified areas of deprivation.

2.1 Overall aim

Approximately 2,000 children attending nursery school in areas of lower socio-economic status (identified by ward of residence according to the 2004 SIMD and FSM% of nursery school attended) from August 2004 until June 2007 were automatically included in the Pip Project (1.12.6). The aim of this research was to:

a) Gain an understanding of dietary intake (with emphasis on fruit and vegetable consumption), and behaviour and knowledge of a sample of the parents and children who resided in these 'lower socio-economic' areas one month prior to the child commencing nursery (baseline)

b) Compare this data to data collected from a sample of parents and children residing in areas considered more 'affluent' who therefore did not qualify for the Pip Project intervention (the 'higher socio-economic group')

c) Compare the baseline data with other research (Payne and Belton, 1992; Gregory et al, 1995; Nelson et al, 2007; Rustin D et al, 2004) and Department of Health (1991) dietary recommendations

d) Identify any changes to the diet, behaviour and knowledge over an 18 month period, comparing data collected from families whose children attended a nursery that received funded interventions through the Pip Project (the 'lower socio-economic group'), compared to those families who did not receive this intervention (the 'higher socio-economic group').

2.2 Objectives

Data was collected at three time points; initial data in August 2005 prior to the date that participating children were commencing nursery, in June 2006 and again in April 2007. The following data would be collected at these time points:

2.2.1 Baseline; August 2005:

1. Measurement of overall dietary intake of participating children and parent by means of a five-day diet diary (completed by the parent). The average intake of energy (kcal/kJ) and the following macronutrients would be determined: carbohydrates (% energy intake); NME sugar (% energy intake); total fat (% energy intake); saturated fat (% energy intake); protein (g/d). As the longitudinal research focused on overall dietary change with emphasis on intakes of fruit and vegetables, intakes NSP (g); Vitamin A (µg); folate (µg); Vitamin C (mg); calcium (mg); iron (mg); zinc (mg); and salt (g) would be identified. Average daily fruit and vegetable intake (g), average number of portions consumed daily and variety of fruit and vegetables consumed over the five-day period were also measured. This baseline diet diary is referred to as 'DD1'in the results section.

2. Comparison of baseline data to key findings from the following research:

   a. The National Diet and Nutrition Survey of children aged 1.5 to 4.5 years (Gregory et al, 1995)

   b. The 1992 Edinburgh based dietary intake study "*Nutritional intake and growth in children*" (Payne and Belton, 1992)

   c. The Food Standards Agency (FSA) Low Income Diet and Nutrition Survey (Nelson et al, 2007)

   d. The National Diet and Nutrition Survey of adults aged 18 to 64 years (Rustin D et al, 2004)

   e. Dietary Reference Values (DRV's) for the United Kingdom (Department of Health, 1991) and relevant updated recommendations from the Scientific Advisory Committee on Nutrition (SACN)

3. Comparison of the dietary intake of adults and children from the 'lower' and 'higher' socio-economic groups

4. Measurement, by means of a detailed questionnaire, of behaviour, knowledge and food preferences of participating adults (and children where relevant).

5. Comparison of behaviour, knowledge and food preferences of participating parents in relation to their socio-economic status.

2.2.2 Stage 2; June 2006 (completion of year 1 of nursery):

1. Completion of 'DD2' to measure overall dietary intake of participating children and parent (as above)

2. Identify changes in intakes of energy and key nutrients from baseline to stage 2, and differences in intakes of the 'higher socio-economic group' compared to the 'lower socio-economic group'

2.2.3 Stage 3; March 2007 (2 months prior to leaving nursery):

1. Completion of 'DD3' to measure overall dietary intake of participating children and parent (as above)

2. Identify changes in intakes of energy and key nutrients from base line to stage 3 and differences in intakes of the 'higher socio-economic group' compared to the 'lower socio-economic group'

3. Measurement, by means of a detailed questionnaire, of changes in behaviour, knowledge and food preferences of participating parents (and children where relevant).

4. Using a case study approach, identify changes in behaviour, knowledge and food preferences of parents (and children where relevant) from the 'lower' socio-economic group who participated for the duration of the intervention.

2.3 Research questions

The following questions will be asked in throughout the research period:

1. Is there a difference in the balance of the diet at baseline between the 'higher' and 'lower' socio-economic groups?

2. Is there any significant change to the dietary intake (positive or negative) over the duration of the research period in either group?

3. Is there a significant increase in the weight in grams (g) of fruit and/or vegetable consumed over the duration of the research in either group?

4. Is there a significant increase in variety of fruit and/or vegetables consumed over the duration of the research in either group?

5. Is there evidence that the consumption of additional fruit displaces the NME sugars such as soft drinks, confectionery and cakes (if fruit (g) increases, does NME sugar (g) decrease)?

6. Is there evidence that fruit is consumed in addition to other snacks, therefore potentially increasing the total energy intake?

7. Does the consumption of additional fruits displace more wholesome foods such as those that contain protein, calcium, iron and zinc?

8. Is there a change in knowledge over time (positive or negative) in parents from either group or as a whole?

3 Methodology

3.1 A critique of methods and validity of dietary assessment

The purpose of dietary assessment is to estimate food consumption or energy and nutrient intake in individuals or groups of people. The appropriate method for dietary assessment will depend on the purpose for which it is needed, for example the researcher may want to measure intake of nutrients, variety or quantity of foods, or eating patterns. There are two main approaches to individual dietary assessments: prospective and retrospective.

Prospective methods for data collection include weighed dietary intake and food records or 'diaries', in which respondents record all foods as they are consumed; Retrospective methods include detailed and standardized 24-hour recalls of all food or drink ingested in the past day, food frequency questionnaires (FFQ's), in which individuals are asked to report usual frequency of intake of a long list of foods over a specified time, or usual frequency of intake of foods targeting a specific food groups or nutrient (Wrieden et al, 2003; Bates et al, 2005). Each of these dietary assessment methods is successfully used in various research or public health settings. Each has merits, associated errors and practical difficulties. Limitations relate to the amount of information that can be obtained, the quality of the data, and differences in the analytic techniques used to provide nutrient or food group estimates (Wrieden et al, 2003; Bates et al, 2005).

3.2 Prospective methods

The main advantage of prospective methods for dietary analysis is that they can provide a direct and accurate measure of the current diet. They can also be carried out for varying lengths of time according to the level of accuracy and the detail required for the research. The main disadvantage of prospective methods is that they are labour intensive for both the participant and the researcher. In addition, the respondent needs to have good language, literacy and numeracy skills in order to fully understand the requirements and to provide accurate report of dietary intake. This limits the use of prospective methods for populations where literacy and numeracy skills are low. Although prospective study methods minimise errors of memory, the knowledge that they are participating in a study may influence subjects' behaviour, so that the food eaten is not a true reflection of their habitual intake. Coding and data entry errors are also very common with these types of data collection (Wrieden et al, 2003; Bates et al, 2005).

3.2.1 Estimated and weighed dietary intake (food diaries)

Weighed dietary intake, which is a widely used method, involves the weighing of all food and drinks over a set number of days (usually between three and seven) by participants or by the researcher prior to consumption, and is used when precision of portion size is required (Bates et al, 2005). This methodology was used in the National Diet and Nutrition Surveys (Gregory et al, 1995; Gregory et al 2000; Rustin et al, 2004). Small scales and utensils are required at each mealtime. A detailed description of the food and its weight is recorded. The strength of the food record approach is that it provides specific details on the amount and kind of food consumed. For such records to be reasonably accurate, respondents need to be motivated, trained, and literate. This method is time consuming for the participant, and requires organisation and equipment, which may lead the participant to change normal patterns of behaviour (eating in the home, eating foods that are more easily weighed, purchasing pre-made foods) or misreporting food consumption for ease of recording. It is also expensive in terms of man-hours required to analyse data, and with limited data available on the composition of many commonly consumed foods, analysis may not be accurate (Ruxton, 1996; Wrieden et al, 2003; Bates et al, 2005). Due to these limitations, it may be necessary to use physiological and biochemical methods to confirm accuracy. Duplicate diet studies involve the test subjects preparing a duplicate portion of all foods and drinks consumed. Collected items are weighed. These are useful for assessing food chemical and nutrient intake, as they do not rely on the composition tables. The data is therefore more accurate. However, this method is very expensive and time consuming, and requires a significant commitment from the participants (World Health Organisation, 1985).

Estimated dietary intakes are often referred to as ‘food diaries’ or ‘diet diaries’. They are similar to the weighed dietary intake method, except that the quantification of the foods and drink consumed is estimated rather than weighed. This estimation is carried out using household measures such as cups or spoons, also photographs of portion sizes, and food models are used to increase accuracy of determination of food portion sizes. The researcher converts these estimates into weights that can then be used to calculate food and nutrient intake. This is a widely used method that has a lower respondent burden than the weighed dietary intake method (Wrieden et al, 2003). Food ‘diaries’ are used in a number of nutrition research settings to measure dietary intake over a single time period, usually from three to seven days. Food records can minimise errors of memory, provided intake is recorded at the time of or immediately after consumption. The smaller the number of days recorded, the greater the risk that the diet recorded is not typical of that consumed over the long term, and the greater the risk that the recorded intake can give an overestimation of dietary quality. However, the quality of recording is known to decline with increasing numbers of days. In addition, for such records to be reasonably accurate, respondents need to be motivated. Therefore most food records range from three to seven days in duration (Wrieden et al, 2003).

Food records have limitations. There is consistent research showing that when individuals are asked to record what they eat, they modify their eating habits by under-eating and/or underreporting their intake to make the task easier and/or to represent their diet in a more positive way i.e. beliefs about which foods are deemed ‘healthy’ and ‘unhealthy’ (see 3.4.3). Research shows that overweight subjects tend to underreport more than normal weight subjects (Wrieden et al, 2003). Even with accurate reporting, a diet record is not thought to represent usual intake, unless it is consistently observed over different time intervals and seasons (Bates et al, 2005). As with the weighed dietary intake method, this method is expensive in terms of man-hours required to analyse data, and with limited data available on the composition of many commonly consumed foods, analysis may not be accurate (Wrieden et al, 2003).

3.3 Retrospective methods

Retrospective methods are commonly used for large-scale studies. They require subjects to recall aspects of their diet over a period of time. Retrospective methods are commonly used because they are relatively inexpensive, not as time consuming to analyse as recorded food intakes, are easier and less time consuming for the participant to complete, and do not introduce the possibility of the study influencing the participants’ behaviour. They can be repeated to gain measure of daily variation and to improve precision. Disadvantages include inaccuracy caused by errors in memory (particularly with the elderly and the very young), perception and conceptualisation of food portion sizes (see 3.4.2 and 3.4.3). This data is dependent on regular eating habits. Food composition tables are required to estimate energy and nutrient intake, which can lead to errors in data entry and analysis (see 3.4.4). Over reporting of foods that are considered healthy is common. This data is prone to underestimation due to omissions. Literacy and numeracy skills are required if the data is self-completed. The main types of retrospective data collection are 24-hour recall, food frequency questionnaires and diet history (Bates et al, 2005).

3.3.1 24 hour recall

Twenty-four hour dietary recalls, in which a trained interviewer asks respondents to report the kind and amount of all food and drink consumed the previous day, are generally used to monitor group mean dietary intakes in population studies. It is generally accepted that a single 24-hour recall does not represent usual individual intake and cannot be used to estimate population intake distributions of nutrients or food groups; multiple recalls are required to represent usual intake of all nutrients and foods, and for nutrients and food groups that are infrequently consumed, many days of data collection may be required. As a retrospective method it relies on an accurate memory of intake, reliability of the respondent not to under or misreport, and an ability to estimate portion size. Advantages of this method include the low level of input required by the respondent, and the ability of the researcher to interview from a distance (by phone or email). Recalls, like records, are prone to underreporting, although the extent of underreporting may vary by quality of the recall. Another disadvantage of 24-hour recall is the requirement for highly skilled interviewers, and the need for standardisation between interviewers (Wrieden et al, 2003; Bates et al, 2005).

3.3.2 Multiple pass recall

The multiple pass recall method was developed in the USA (1999 – 2000) to assess diet in large population studies of children and adults. According to Wrieden et al (2003), ‘using this method, the diet is assessed over a period of three to five days during which the respondent is asked to recall and describe all food and drinks consumed in the 24 hours prior to the interview. Interviews can be a combination of face to face and telephone’. ‘The *multiple pass* refers to the steps involved during interview to allow revisiting and checking of dietary information: in the *first pass*, a quick list of foods consumed is obtained; in the *second pass*, information about the meal / snacks consumed (including time and place) is recorded. The *third pass* prompts for foods that may have been forgotten. Finally a review of the record and further details of foods consumed and portion sizes are completed. The method has been modified with the specific aim to minimise under-reporting and the burden on respondents’ (Wrieden et al, 2003). The method was adapted and validated for measuring energy intake in a Scottish sample of preschool children (Reilly et al, 2001, cited in Wrieden et al, 2003) and also used to gather data for the Low Income Diet and Nutrition Survey (Nelson et al, 2007). This method is considered fast and effective for investigators as there is a lower burden on the respondent. There is improved precision compared with 24-hour recall. As with all retrospective methods the research is memory dependent, and has potential for misreporting foods consumed based on the conception of what foods are 'good' and 'bad'. Portion size may also be misreported. Data entry can be labour intensive (Wrieden et al, 2003).

3.3.3 Food frequency questionnaires

Food frequency questionnaires (FFQs) are flexible and as such, can be used in a variety of study designs (Cade et al, 2002). They are self-administered instruments in which respondents are presented with a long list of items and asked to report usual frequency of consumption over a specific time period. The strengths of the FFQ method are that it is designed to obtain data regarding usual intake and is much less costly to administer and code than recalls or records. There is a low burden on the respondent. FFQ's can be self-completed, and can be posted. Therefore, the FFQ has been the method of choice for large-scale epidemiological studies. However, FFQs lack the detail and specificity of records or recalls. The food list found on FFQs is, by design, largely composed of frequently consumed foods. Many FFQs do attempt to collect information about portion size in addition to frequency of consumption; these are often referred to as semi-quantitative FFQs. Where portion size information is not obtained standard food portion sizes are often used to calculate nutrient intakes. This can lead to under-estimation of 'unhealthy' food consumed, and over reporting of intake of 'healthy foods' (see 3.4.3). Research by Subar et al (2003) found that compared to 24 hour recall method, there was much higher likelihood of underreporting for both energy and protein in male and female participants using a FFQ. The nutrient database lacks specificity and relies on nutrient content of the most common form in which foods are consumed rather than on specific forms. Usual portion sizes are either assumed or queried in a general fashion. In addition, completing FFQs is cognitively difficult, requiring good memory and estimation skills. Many FFQs available today can be adapted to meet particular research needs. There are limited FFQs for culturally specific populations (Sharma, 2011). There is a continuing need to adapt methodologies as research in diverse and distinct socio-cultural populations expands. (Wrieden et al, 2003; Bates et al, 2005).

3.3.4 Diet history

A diet history focuses on a subject's typical intake over a period of time, with information obtained through an extensive interview. Data gathered is extensive.

However, the detailed nature required to obtain this level of detail introduces the possibility of the interviewer 'leading' the subject to recall foods expected or desired in the participant's diet. In addition, the subjective nature of the interview makes standardisation of the analysis difficult (Bates et al, 2005).

3.4 Sources of potential error in dietary methodology

Given the nature of the data collected, it is widely understood that diet recording and recollection contains various elements of error and bias. There are a number of sources of potential error when carrying out this type of research.

3.4.1 Sampling bias

If the sample used for a study is not randomly determined, the data will not be representative of the population as a whole. Respondent bias affects many dietary studies. If subjects are allowed to opt in or out, participants most interested in health and nutrition will be more likely to participate, and a 'self-selection effect' will be observed (Bates et al, 2005). Multiple studies have observed non-participation and high dropout rates from obese candidates, which suggests population studies are not representative of all weight categories, which subsequently affects descriptive epidemiology, and can distort analytical results (Lissner, 2002).

3.4.2 Recording error

People may not record what they actually eat. These inaccuracies may be unintentional, for example there may be errors in weighing food, in writing down weighed or estimated food, forgetting to record food at the time of consumption and relying on memory which may lead to inaccuracies such as and unintentionally omitting it at a later time or misreporting the food consumed, or the inability to accurately estimate portion sizes (Bates et al, 2005).

3.4.3 Over and under-reporting

An extremely important and problematic source of error in dietary studies is that caused by over- and under-reporting, and this varies significantly from study to study and method to method. When observing the results of the OPEN study, Subar et al (2003) found a significantly greater disparity on reporting between 24 hour recall and FFQ's; on average males underreported energy intake by 12-14% using a 24 hour recall method, compared to 31-36% using the FFQ, and for women the result was 16-20% and 34-38%

respectively (Subar et al, 2003). Weighed intake studies in particular have been found to interfere with normal eating behaviour. This may be categorised as 'social desirability bias", which implies a "tendency to supply answers to dietary questions that place the interviewee in a favourable light" (Lissner, 2002). This behaviour can be either intentional, or a form of self-deception; subjects may avoid eating foods perceived as 'unhealthy' or not record them when they do (Lissner, 2002; Livingstone et al, 1990). There is a general tendency for individuals to report not what they actually eat, but their 'perceived norm' for the population with which they identify (Schoeller, 1990, cited by Ruxton, 1996). Subjects may also eat less, or simplify their eating patterns, to make the recording process more straightforward (Wrieden et al, 2003). Underreporting is the more frequent of these forms of misreporting, and may be seen across all food groups, though energy-dense and carbohydrate dense foods are most likely to be under-reported (Krebs-Smith et al, 2000). This may mean that data for nutrients found in energy and carbohydrate dense foods such as sugar, fat, saturated fat and fat-soluble vitamins are also likely to be under-estimated. Certain sectors of the population are more likely to under-report, and serious underestimation of intake can particularly be seen in obese populations (Lindroos et al, 1993). This has become more documented with the use of doubly labelled water (DLW) technique to compare reported intake to TEE. Lissner (2002) concluded that "selective underreporting of certain food types by obese individuals does occur", and that "correction for energy intake is not sufficient to eliminate the biases from this type of error in both obesity-related selective reporting errors and more universal types of selective underreporting, e.g. foods of low social desirability". A study funded by the Food Standards Agency (2002) study observed changes in both eating and recording behaviour when individuals were identified when obese individuals were asked to record their intake. The observation effect appeared to have certain macronutrient specificity, where in that women reduced their fat intake (-12%) and men their alcohol intake (–13%). Overall the observation effect led to a decrease of 5% of energy intake. People also misreported their eating behaviour, where depending on the intake measurement used, a difference of 'actual intake' to 'reported intake' varied from 5 to 20%; this was more marked in individuals when the measurements were carried out in their own homes as compared to a controlled laboratory setting (cited in Wrieden et al, 2003).

3.4.4 Error of food composition data

Most studies that require dietary analysis utilise software that is based on the Royal Society of Chemistry's food tables contained in McCance and Widdowson's 'The Composition of Foods' (Food Standards Agency, 2002). It is widely acknowledged that although values contained in these tables are derived from careful analysis of representative samples of each food, all foods vary in composition, based on a variety of factors.

The nutrient content of unprocessed plant or animal based foods depends on their variety, age, and the conditions in which they were grown or raised. The storage of food, including the temperature, the facility and the length of time stored will also affect a food items' nutrient content. Nutrient composition of manufactured food products varies widely between brands. The increasing addition of nutrients for fortification, colouring or antioxidant purposes also means that figures in food tables may not be a true representation of foods eaten by the sample population. The composition of many processed foods has also changed over the past two decades, which means that more recently developed composition tables are required for accurate data to be produced. Loss of validity due to variation in manufactured products can be minimised by using nutrient data supplied by individual manufacturers, but this is time consuming and also depends on study participants reliably recording brand details (Ruxton, 1996).

Table 3.1: Major error sources in recording of food consumption (Ruxton, 1996; adapted from Bingham, 1987)

Sources of error	Weighed record	Estimated record	24-hour recall	Diet history / FFQ
Weights of food	-	+	+	+
Frequency of consumption	-	-	-	+
Respondent bias	+/-	+/-	+/-	+/-
Interviewer bias	-	-	+ / -	+ / -
Daily variation in intake	+	+	+	-
Reporting error (additions/omissions)	+ / -	+ / -	+ / -	+ / -
Change in diet	+ / -	+ / -	-	-
Sampling bias	+	+	+	+
Food tables	+	+	+	+
Coding errors	+	+	+	+

+ = error present - = error unlikely + / - = error possible

Participants may list incomplete information in food diaries, for example listing 'milk' but not whether it was skimmed, semi-skimmed or full fat. In these cases, the researcher will generally base their analysis on the option most frequently consumed, which may lead to slight differences between 'actual' and 'reported' consumption (Ruxton, 1996). Additional error may be introduced when entering food intake data into computer software, for example errors can occur when interpreting entries in food diaries, or coding and entering foods for analysis (Bates et al, 2005).

3.5 Reducing Risk of Error

There are a number of ways in which the level of error in dietary analysis methodology can be reduced. Validation studies are often used to support the dietary data collected. Systematic error is generally minimised by increasing the number of participants, and increasing the number of measurements taken (Bates et al, 2005). The validity of a study can be tested, by comparing the results with those from a study that has used a standardised, objective methodology.

To validate studies that involve dietary records, studies have often been designed to include other research methodology including physiological and biochemical methods such as doubly labelled water assessments, which uses the natural occurring stable isotopes of water (D_2O and $H_2{}^{18}O$) to assess energy expenditure, body composition and water flux. In studies where a person other than the subject is responsible for recording dietary intake, such as studies that involve parents of young children, energy intake generally corresponds to doubly labelled water determined energy expenditure. However, in instances where the subjects report their own intake, energy intake is generally under reported when compared with energy expenditure. This under-reporting has been linked to increased adiposity and body size, and other factors, such as dietary restraint and socio-economic status (Hill & Davies, 2001).

Although validation studies are desirable to test a new methodology, these approaches are not always feasible as they can be time consuming for the participants and the researcher, and also expensive. For example, research using a 'metabolic kitchen' involves the researcher chemically analysing the composition of all foods consumed by the participant, on in some cases, preparing the food that the participant then consumes. Although this method gives the researcher complete control and the most valid nutritional data, the method is expensive and time consuming for the researcher, as well as time consuming and invasive for the participants. Although useful in some studies such as those looking at the specific biochemical effect of a particular nutrient or synergy of nutrients on a particular cohort of participants, for the purposes of this study, it would not be possible to centrally prepare foods in a 'metabolic kitchen' for distribution, or to analyse all items prepared, as participants are expected to choose their own food items and preparing foods using their own dishes, and the additional requirement of providing samples may cause participants to distort the foods consumed.

Analysis of doubly labelled water required specific laboratory analysis that may not be available, and is therefore this method of validation is not always practical (Thompson & Byers, 1994; Wrieden, 2003). This method is also expensive. The ratio of reported energy intake to basal metabolic rate (EI / BMR) is often used to test the accuracy of food records, with a ratio below a certain value usually regarded as an implausibly low reported energy intake, in other words, too low for the maintenance of body weight. This ratio is commonly known as the Goldberg cut-off (Goldberg et al, 1991). However, if the Physical Activity Level (PAL) on which this cut-off is based is inappropriate, subjects will be wrongly excluded from data analysis, and determining the most appropriate PAL is still under debate (Livingstone & Robson, 2000). A study by the Food Standards Agency (2002) found that the sensitivity and specificity of the Goldberg cut- offs was poor at detecting a change in eating behaviour (Wrieden et al, 2003). With this in consideration, there is a need for objective and accurate dietary assessment instruments such as new nutrient biomarkers and alternatives to doubly labelled water that are cost effective, simple to use and not time consuming (Bates et al, 2005).

3.5.1 Observation

The accuracy of dietary records may be validated by comparison with observation (by parents/guardians, staff at a canteen, or trained observers) of the food actually eaten. However, this method is not suitable for studies that require observation of intake at every meal over a number of days (Lytle et al, 1993).

3.5.2 Portion size

Assessing nutrient intake at an individual level requires determination of portion size for each food consumed (Foster et al, 2008). Without clear guidance on portion size, there may be significant over or under reporting from participants leading to invalidity of data, particularly when using retrospective methods for data collection (Howat et al, 1994). There are a number of methods by which portion sizes can be identified in dietary assessment research. This may include researchers weighing certain food items on the individual's behalf, the use of photographic tools (e.g. Nelson et al, 1997) or food models to demonstrate portion sizes of commonly eaten foods, data from manufacturers, and the use of household measures (Wrieden et al, 2003; Bates et al, 2005). Research by Nelson et al (1996) found large variations in the estimation of portion size from photographs. In general, small portions sizes tended to be overestimated and large portion sizes were underestimated. Age, gender and BMI were all found to be potentially important factors when estimating food consumption or nutrient intake using photographs; BMI greater than 30 was associated with an 8 % underestimate in portion size from photographs (Nelson, 1996). The size, colour and type of photo may have an impact on estimation of food consumption (Nelson et al, 1996).

There has been a significant amount of research to determine portion sizes for pre-school children over recent years, however evidence based portion sizes have not been specified (More & Emmett, 2014). Wrieden et al (2008) used data from the National Diet and Nutrition Surveys of children aged 1.5 to 4.5 years (Gregory et al, 1995) and young people aged 4 to 18 years (Gregory et al, 2000) to determine portion sizes of a range of food items for children at different ages. Further research by More & Emmett (2014) used the Gregory et al data and the Avon Longitudinal Study of Parents and Children (ALSPAC) to develop portion sizes and a theoretical food plan, which was found to provide an adequate intake of all nutrients, with the exception of Vitamin D. The British Nutrition Foundation 5532-a-day resource is a valuable guide for providing a balanced intake of foods for preschool aged children, and provides recommendations for portion sizes for foods from four of the food groups (British Nutrition Foundation, 2015).

Although dietary recall in adults may lead to under-reporting, Research by Foster et al (2008) found that children aged four upwards have the ability to accurately determine portion sizes of foods consumed when provided with photographs, food models and other assessment methods even over an extended time period (24 hours), and that age appropriate portion sizes greatly increases the accuracy of estimates (Foster et al, 2006). For determination of portion size by children, one successful method is the use of ISPAS, an interactive computer-based portion size assessment system, which has been developed for use children in dietary research studies such as 24 hour recall and interviews and provides digital images of portions of foods relevant for the age of the child participating, which are directly linked to the UK composition of food codes for accurate analysis (Foster, 2014). This program is under further development to increase the number of visual images and to provide a wider range of food items, various portion size options and include visual examples of leftovers, so that analysis is more accurate (Foster et al, 2009).

3.5.3 Number of days required

The 7 day weighed record was previously considered as the ‘gold standard’ against which less detailed and demanding methods could be compared. It is now recognised that this method also has limitations (Wrieden et al, 2003). The number of days that the participant is required to collect dietary intake data may impact on the compliance and the willingness to participate in a study. The number of days required to accurately determine the average food or nutrient intake depends on a number of factors, including the nutrient or nutrients under consideration, the subjects’ age group, gender, and the variability characteristically seen in their diets. Nutrients requiring the most days to accurately assess their intake tend to be those found in high levels in infrequently eaten foods, and also showing high variability such as retinol, carotene and Vitamin B12 (Nelson et al, 1989). The nutrients with the lowest variances, such as energy, protein, saturated fat and calcium, require the least days to adequately estimate intake (Nelson et al, 1989).

A study by Edington et al (1989) found no significant difference between 4 day and 7 day estimated weight food records in adults, concluding that it is acceptable to decrease days of recording. A study of adults by Karvetti & Knuts (1992) determined that 2 day estimated intake food records to provide ‘satisfactory’ validity at group level, and ‘probably acceptable’ for individuals. A study of graduate students (Todd et al, 1983) found 1-day food records (weighed and estimated) to give a reasonable estimate (within 15%) of usual intake for groups, but a meaningless estimate of usual intake for individuals. Payne and Belton (1992), concluded differences in comparative results may have been a consequence of the degree of error incurred in assessing an individual's micronutrient intake over a period of only five days. For the intake of vitamins and minerals for individuals, Bingham (1987) suggested that a dietary assessment of 10 to 20 days would be required to give an accuracy of ±10 %.

3.6 Dietary analysis technique used for this research

For this research it was decided that, given the detail required, a prospective diet diary method would be used. In order to demonstrate the variation in the diet, participants were asked to complete a five-day diet diary, to include 2 weekend days and 3 weekdays. Photographic figures from the Food Standards Agency of commonly consumed food items were provided to assist participants with determining portion sizes. Of the prospective methods for data collection, this method was the least labour intensive, the least time intensive and the most cost effective method available. It was selected in preference of a weighed inventory method for simplicity and speed of recording, and because the information could be gathered without the use of equipment such as household scales. However, it is noted that there is a loss of precision when collecting data using this method compared with the weighed inventory method.

3.7 Methodology used in this study

3.7.1 Study design

For this study, families were assessed using both quantitative and qualitative methods. Data was collected at times when the children were not in nursery to determine a clear representation of the impact of the Pip Project on the diet in the home; initial data was collected prior to the commencement of nursery, Stage 2 data was collected at the beginning of the summer holiday and stage 3 data was collected in the Easter break. The reasoning behind the design of this research is as follows:

1. Baseline dietary data, gathered in August 2005 (the month prior to the child commencing nursery) would give an understanding of the overall dietary intake of participating child and their parent prior to exposure to the initiatives as set out in 1.12.6

2. Children in Scotland attend nursery for 2 years. Dietary data gathered after a 10-month period in early June 2006, would give an indication of overall energy intake and specific changes to nutrient intake and fruit and vegetable consumption in the first year of nursery; dietary data gathered at 20 months after baseline, in late March 2007, would give an indication of overall energy intake and specific changes to nutrient intake and fruit and vegetable consumption as the child approached the end of their nursery experience.

3. A questionnaire, containing a combination of quantitative and qualitative questions, completed as baseline, would give information relating to fruit and vegetables preferences of both children and their parent. In addition the

questionnaire would provide information relating to parental knowledge, attitude and cooking skills.

4. This questionnaire would be completed again at stage 3 to determine changes in preference, knowledge, attitude and aptitude over the 2 years that the child attended nursery.
5. Data from the diet diaries would be analysed using WinDiets dietary analysis program. The quantitative result from the analysis of a five-day diary would then be entered into SPSS v17 for analysis.
6. Data gathered from the questionnaires would also be entered into SPSS v17 for statistical analysis (SPSS Inc.; 2008).

3.7.2 Pilot study

In March 2005, a pilot study was carried out to assess the ability of parents to understand and successfully complete the Pip study diet diary and the questionnaire. Three nurseries were selected to participate in the pilot study. The nurseries selected were from different areas in the city of Edinburgh, with one nursery in the ward with the highest % free school meals (FSM %) and highest SIMD (Scottish Index of Multiple Deprivation) score; one nursery from a ward with a middle range FSM % and SIMD score; and one nursery with a low FSM % and SIMD score. These nurseries each nominated four parents to participate in the pilot study focus group. All participating parents received a hamper of fruit and vegetables for their participation. An initial meeting was held with staff and parents in each nursery. A copy of the Pip study questionnaire, diet diary and diet diary instruction manual were distributed to participating parents. Parents were asked to review the instruction manual and make comments regarding anything that was not clearly explained; to attempt to complete the diet diary for both themselves and their child for a two-day period; and to complete and make comments on the content of the questionnaire.

One week later, a 2nd focus group was held with the parents at each of the participating nurseries to receive feedback on the three documents provided, which included:

"I didn't really understand what a portion was"
"Some of the pictures weren't clear and I didn't know what to write"
"It would be great if there were more pictures of foods as a guideline"
"The example of the completed diary really helped me"
"There was a lot to read. Is there a way to make it more simple?"

"It was a lot to write down, I don't think I could do that for 5 days"

"Is it possible to have everything in one diary rather than in two?"

"What if I shop at different places? Can I tick 2?"

"I didn't really understand the question about how often I make foods"

Following the focus group, the researcher reviewed the completed diet diaries and questionnaires to identify any common errors in completion. All feedback was taken into consideration, as was the way in which the participants responded to certain questions, and the diet diary and questionnaire were amended accordingly prior to the distribution to parents participating in the Pip study. As the purpose of the focus group was to ensure that the documents were easily understood, and not to determine accuracy of dietary intake, the dietary data provided was not analysed in WinDiets to assess its efficacy.

3.7.3 Group categorisation

Once the baseline data was collected and the children began nursery, each family was assigned to a research group depending on which nursery the child was attending. Parents and children from nurseries in wards with the highest SIMD scores in the city (the most affluent areas) and nurseries attached to or close to schools with the lowest % free school meals constituted this 'higher SES group'. These nurseries were not eligible for funding through the Pip Project. Of the nurseries in the 'higher socio-economic' areas who opted to participate, three were randomly selected to be the control group; these are Group 1. The other nurseries were assigned to Group 2.

Parents and children in Group 3 are considered the 'lower SES group'. At the time of Pip Project design, all nurseries were scored using their SIMD ranking (using the 2004 SIMD report), and the percentage of children attending the school who were eligible for free school meals. Nurseries in wards with the lowest SIMD ranking in the city of Edinburgh, nurseries in geographical clusters with the lowest SIMD ranking, and nurseries attached to or geographically close to schools with the highest percentage of children who were eligible to free school meals constituted the 'lower SES group'. All of the participating parents and children who attended these nurseries were placed in Group 3 and were entitled to full support from the Pip Project:

Group 1 (no intervention): constituted the control group, and consisted of participants whose children attended a nursery that would not receive any resources or free fruit and vegetables for the duration of the study.

Group 2 (health education only): Participants whose children attended nurseries that would receive the resources and annual health promotions only.

Group 3 (health education plus fruit and vegetables): This group consisted of participants whose children attended a Pip Project funded nursery; these children received 3 pieces of free fruit or vegetables per week, equating to approximately one 'child size' portion of fruit or vegetables per day. A variety of fruits and vegetables were provided to the nurseries weekly to encourage children to broaden their range of intake. In addition to the free daily fruit and vegetable provision for children, and a subsidised weekly provision of fruits and soup packs, all of the Group 3 nurseries offered a wide range of interventions for parents and children. The following table outlines the interventions held within the specified nurseries:

Table 3.2: Table to show the promotions throughout the duration of the research period

Date	Promotion
September 2005	Educational sessions were held with parents on the topic of 'Foods containing fat, salt and sugar' (group 3 parents only).
October 2005	Halloween: each child was given a mini pumpkin to carve as part of the nursery school Halloween party. Recipes were also provided (group 3 children only).
November 2005	Educational sessions were held with parents on the topic of 'Food labelling and common food myths' and 'Meal planning' (group 3 parents only).
December 2005	'Vegetable men': health promotion staff attended each nursery with a range of vegetables to carry out an activity that allowed children to familiarise themselves with a range of vegetables (group 3 children only)
January 2006	Soup making sessions were held with parents (group 3 parents only).
February 2006	Cress heads: each child was given a take home pack containing a pot, cotton wool, cress seeds, wiggly eyes and an instruction leaflet. Nurseries were given additional packs to demonstrate the activity (group 3 children only).
March 2006	Educational sessions were held with parents on the topic of common food related myths (group 3 parents only).
	'The Hungry Caterpillar': health promotion staff visited each group 3 nursery with 'The Hungry Caterpillar' book and fruit / food items from the story and carried out an interactive story time; nurseries carried out activities from the Pip Project Activity Pack throughout the week (group 3 nurseries only).
April 2006	'Fruit faces': health promotion staff attended each group 3 nursery with a range of fruits to carry out an activity that allowed children to be creative with fruit (group 3 children only).

May 2006	Smoothie making sessions were held with parents and children (group 3 only).
June 2006	Fruit Olympics: a 'fruit' theme sports day was held at nurseries across the city; a range of plastic fruit was used for activities such as coconut bowling, kiwi and spoon, carrot baton relay, grapefruit shot put and cucumber javelin. Each child received a plastic Olympic medal and a bag of 5 pieces of fruit to take away. Parents were given fresh smoothie lessons, and fresh summer strawberries were distributed on the day (group 3 and group 2 parents and children).
September 2006	Education sessions were held with parents on the topic of 'Healthy packed lunches' (group 3 parents only).
October 2006	Halloween: each child was given a mini pumpkin to carve as part of the nursery school Halloween party. Recipes were also provided (group 3 children only).
November 2005	Educational sessions were held with parents on the topic of 'The balance of good health' (Eatwell plate) and 'portion sizing' (group 3 parents only).
December 2006	'Vegetable men': health promotion staff attended each group 3 nursery with a range of vegetables to carry out an activity that allowed children to familiarise themselves with a range of vegetables (group 3 children only)
January 2007	Soup making sessions were held with parents (group 3 parents only).
February 2007	'Fruit faces': health promotion staff attended each group 3 nursery with a range of fruits to carry out an activity that allowed children to be creative with fruit (group 3 children only).
March 2007	Red nose day: all children were given a large red vine tomato and a range of pre-chopped vegetables to create a 'red nose day face' to acknowledge red nose day (group 3 children only).

3.7.4 Recruitment of nurseries

In November 2004, permission was granted by the City of Edinburgh Councils' (CEC) "Quality Services Resources and Research Officer" for all council sector nurseries to be approached to request permission to recruit parents to participate in the study (see Appendix 1). As per the policy of the CEC Education Department, the decision as to whether a nursery could participate in the research was that of the Head of each primary school (or Head of nursery, in the instance of the nursery not being attached to a primary school, as was the case in 12 nurseries at the time of data collection).

In December 2004 all 45 council sector nurseries that were participating in the Pip Project were contacted, and in January 2005 all other nurseries (54) were contacted. Contact was in the form of a letter, with information outlining the aims and objectives of this research and a request to recruit parents of children who would be commencing nursery in late August 2005. A consent form was also provided. This was to be completed and returned if the Head of primary (or Head of nursery) was willing to allow recruitment of parents. In total, 32 nurseries across the city of Edinburgh gave permission for recruitment of parents from their nursery. Of these, 21 were nurseries that were receiving interventions through the Pip Project, and 11 were nurseries that did not receive interventions through the Pip Project. The participating nurseries were spread over 22 council wards and 10 postcodes. By ward, the mean free school meal percentage (FSM %) was 29.6 % with a minimum ward average of 10 % FSM and a maximum ward average of 49 % FSM. By school, the mean FSM % was 22.3 % with minimum 6 % FSM and a maximum 52% FSM. For a list of all participating nurseries please see Appendix 2.

Of the 11 nurseries that were not receiving Pip Project interventions, the decision was made to further segregate these nurseries into two subgroups. This would include a control group (Group 1), which consisted of 3 nurseries assigned to this group with permission from the head teacher, would receive their Activity Pack, resources and backdated intervention at the end of the research period. ‘Group 2’ - a group made up of the remaining eight participating “higher socio-economic” nurseries - would receive one intervention (the “Fruit Olympics”, which occurred in June 2006), and all resources (the Pip Project Activity Pack, a smoothie maker, fruit peelers, kiwi spoons, recipe and educational books).

3.7.5 Criteria for participation

For the purpose of this thesis, the word ‘family’ has been used to describe the smallest unit which is formed of a parent and child recruited for participation in this research, and the term ‘parent’ has be used for the adult who acted as the primary carer for the child, and was responsible for completing the diet diaries and questionnaires. All participating parents were female. To participate in this research, the child was required to be three years of age by August 2005, and would turn four within the upcoming academic year (between August 2005 and July 2006), meaning that the child was entering the initial year of a two year council funded nursery placement, having not previously attended a council sector nursery before. Required minimum attendance was 2 and a half hours per day, five days per week which is the standard attendance in council sector nursery in Edinburgh.

3.7.6 Recruitment of participants

The majority of the participating nurseries held open days for new parents in May and June 2005. The researcher attended 23 of these; there were four open days that conflicted and were attended by other ECFI employees, who were fully aware of the requirements from parents, and the inclusion criteria. Parents were provided with a booklet containing information relating to the purpose of the research and what would be required from them over the 20-month period. At nurseries that did not host an open day (n=5), information was provided and distributed to parents by nursery staff. All parents of incoming children who met the criteria for the research were offered the opportunity to participate in the study. Although nursery staff encouraged all parents to participate, ultimately participation was self-determined. Of the 32 nurseries that agreed to participate, parents were successfully recruited from 23 nurseries.

3.8 Data collection

The following chapter outlines the nature of the resources used by the researcher to gather the required information, and the method for data collection:

3.8.1 The questionnaire

A questionnaire was designed to assess parents' cooking and food preparation skills, knowledge and understanding of the NHS 'five a day' message; and fruit and vegetable preferences of both parents and children. A Likert scale was used (1 to 5) for questions such as fruit and vegetable preferences ('really dislike to really like') and on attitudes towards statements relating to barriers to healthy eating ("really disagree to really agree'). All questions were coded and data was analysed using SPSS v17. Questions relating to cooking skills required qualitative responses and these have been summarised in section 4.3. See appendix 3.

3.8.2 The diet diary

All participating parents were provided with a diet diary that they were asked to complete for a period of five days, noting all food and drinks consumed by themselves and their child. A diet diary instruction manual was provided, which contained detailed advice and assistance regarding the completion of the diary, including Food Standards Agency guideline photographs of portion sizes (see appendix 4).

3.8.3 Collection of data, baseline

Participants were asked to complete and return a consent form and a contact details form at the time of recruitment (June 2005). The contact details form contained full name, name of child, a home address and contact number. This data was entered into a Microsoft Access database, which was used to track participation for the duration of the research period. Parents who did not wish to provide contact details had the option of collecting their envelope from the nursery that their child was enrolled in. However, all parents provided contact details. In late July participating families were issued with an envelope containing a covering letter, a stamped addressed envelope, a diet diary with full instruction manual, and a questionnaire. This diary was coded 'DD1' for diet diary 1 and the questionnaire was coded 'QU1' for questionnaire 1. These items were issued to parents from ECFI head office by mail. Where requested, the researcher visited the family in their home, or arranged to meet parents at the prospective nursery to further explain the procedure for completion. In total, the researcher visited the homes of seven families.

One week after the envelope was issued; families were contacted by telephone to ensure that they had received it, and to answer any questions. If any families had not received their envelope, a second diary was issued by mail. Envelopes were returned either by mail in the stamped addressed envelope provided, or via the nursery. Families were given two weeks to complete and return their diaries, at which time a second call was made to see if parents needed any further assistance. A further two weeks was given. If the diary was not returned, a withdrawal slip was both mailed out, and distributed to parents through nursery staff, so that parents could complete and return if they no longer wished to participate in the research. If no diary or withdrawal slip was received after a further four weeks, it was determined that the family no longer wished to participate in the research, their status in the Microsoft Access database was changed to 'inactive' and their details were removed from the mailing list.

3.8.4 Collection of data, stage 2

In June 2006 the second diet diary was issued to all parents who had completed and returned the baseline diet diary. This diary was sent to parents from ECFI head office by mail, and a stamped addressed envelope was enclosed. This diet diary was coded 'DD2' for diet diary 2. Also enclosed was a form for parents to complete if they no longer wished to participate in the study. Parents were contacted one week after the envelope was mailed to check that it had arrived, and to ask if the parents were still willing to participate. A second telephone call followed if the diet diary had not been returned within two weeks of the initial telephone call. If parents completed and returned to form to state that they no longer wished to participate, their status in the Microsoft Access database was changed to 'inactive'. If the diary was not returned within a further two weeks, it was determined that the parent no longer wished to participate in the research, their status in the Microsoft Access database was changed to 'inactive' and their name was removed from the mailing list.

3.8.5 Collection of data, stage 3

In March 2007 the 3rd diet diary (DD3) and a 2nd questionnaire (QU2) was issued to families who had completed and returned the stage 2 diet diary. A form was enclosed for parents to complete if they no longer wished to participate in the study. As with the initial and 2nd envelopes, a telephone call was made following one week to ensure that the envelope arrived, and to ask if the parents were still willing to participate. A second telephone call followed if the diet diary had not been returned within two weeks of the initial telephone call. If parents completed and returned to form to state that they no longer wished to participate, their status in the Microsoft Access database was changed to 'inactive'. If the diary was not returned within a further two weeks, it was determined that the parent no longer wished to participate in the research, their status in the Microsoft Access database was changed to 'inactive'.

3.8.6 Data review

All participating nurseries were allocated a number, and each child and parent was given an individual code according to the nursery that they attended to create anonymity. For example, a parent and child who attended Abbeyhill nursery was coded ABB1. This was further broken down with the variable 'A' for adult and 'C' for child. As diet diaries and questionnaires were received from parents, codes were printed on stickers, which were placed over the parent or child name to ensure anonymity. The code placed in the diet diary or questionnaire would reflect both the parent code and the stage of the research (example: ABB1DD1 would represent participant ABB1, diet diary 1). All diet diaries and questionnaires received at baseline, diet diaries received at Stage 2, and diet diaries and questionnaires received at Stage 3 were reviewed to determine if they had been completed according to the guidelines provided. Diet diaries that had not been completed adequately were discarded. For information regarding the number of diet diaries and questionnaires that were successfully completed, please refer to the schematic diagram (section 4.1).

3.8.7 Dietary data entry and analysis

All parent and child diet diaries were entered into WinDiets Nutritional Analysis program (Wise, 2005) between April and September 2007 (see section 4.2.1). Each diary had been completed over a five-day period. For each completed diary, the code that had been allocated was used to open an electronic diet diary (example: ABB1-A-DD1 = Participant ABB1; A=Adult, DD1=Diet Diary 1). Once all dietary information provided was entered into WinDiets, each diary was analysed to provide the mean daily intake. This information was printed off, manually entered into SPSS v 17, and filed with the completed diary.

WinDiets allowed analysis for seven days' food intake, which was more than adequate for this research. Dietary information was entered using selected codes. In the event of an absence of detail, a standard code was identified and used for all diaries (example = "bread" was entered as "medium white slice bread"). In instances where recipes were not given (example = Spaghetti Bolognese), the standardised recipe provided in Windiets was used. Where processed and pre-packaged foods that were not included in the WinDiets database were consumed, the recipe according to the packaging was entered into the 'recipe analysis' function of the WinDiets program and analysed. A 'medium' portion size was allocated where participants had not entered a portion size. These were determined using 'Food Portion Sizes' (Mills et al, 2002).

Windiets analyses food data and provides information on the following nutrients: energy, kcal, fat, saturated fat, monounsaturated fat, polyunsaturated fat, protein, carbohydrates, sugars, starch, non-milk extrinsic sugars, non-starch polysaccharides, alcohol, water, Vitamin A, thiamine, riboflavin, niacin, Vitamin B6, Vitamin B12, folate, biotin, Vitamin C, Vitamin D, Vitamin E, calcium, magnesium, sodium, potassium, chloride, phosphorus, iron, zinc, copper, manganese, selenium, iodine, dietary fibre, cholesterol, retinol, carotene. To limit statistical analysis to manageable proportions it was decided to reduce the number of nutrients listed to the most commonly analysed. It was also decided to include any nutrients that might be indicative of an increased consumption of fruit and vegetables. The nutrients selected for use were: kcal (and kJ); carbohydrates (% of daily energy intake); NME sugar (% of daily energy intake); total fat (% of daily energy intake); saturated fat (% of daily energy intake); protein (g/d); NSP (g/d); Vitamin A (μg); folate (μg); Vitamin C (mg); calcium (mg); iron (mg); zinc (mg) and salt (g/d). This data was entered into SPSS v 17 (see table 4.2).

NB: This research focused purely on dietary intake and did not take into account whether parents were consuming nutrients through supplements. All data accurately completed by participants was included, even when energy and nutrient intake was significantly lower or higher than the EAR. No anthropometric data or data regarding energy expenditure was collected, which could have been used to corroborate the data for energy intake.

3.8.8 Entering data into SPSS

Dietary data from WinDiets was manually transferred to an SPSS v 17 spread sheet developed by the researcher. The following variables were created to differentiate the participants: child gender; ethnicity; intervention group (where 1 = control nursery; 2 = non-Pip funded nursery; 3 = Pip funded nursery); home postcode; postcode of nursery; free school meal percentage of nursery attended; average % free school meal; geographical data zone where nursery was based; 2004 SIMD ranking.

Variables were created for the following nutrient and dietary intakes at baseline, stage 2 and stage 3 of the research period: Mean daily energy intake; carbohydrates (% of daily energy intake); NME sugar (% of daily energy intake); total fat (% of daily energy intake); saturated fat (% of daily energy intake); protein (g/d); NSP (g/d); Vitamin A (μg); folate (μg); Vitamin C (mg); calcium (mg); iron (mg); zinc (mg) and salt (g/d). Average daily fruit and vegetable intake (g); average number of portions consumed daily; variety of fruits eaten; variety of vegetables eaten. Variables were also created for each of the questions in the baseline and stage 3 questionnaires. If no data was provided for any of the variables, the code 999 was entered.

3.8.9 Analysis in SPSS

Although the total number of adult and child participants was low (n=48 at baseline), the data was reviewed in SPSS, and normal distribution was observed, therefore parametric method of data analysis (t-tests) was used throughout. ANOVA was used when comparing the baseline data to other national data and to the SACN guidelines, and Independent t-tests were then used comparing the Pip study result to the mean result from each of the other studies and the SACN guidelines to calculate significance. Independent t-tests were used to compare mean intake (+/- 1 SD) in terms of weight (g) and variety of fruit and vegetables; energy (kcal/kJ); macronutrients (% energy intake); protein (g/d);

and selected micronutrients (mg and μg) by adults and children from different SES groups over the research period. Independent t-tests were used to compare change in intake between the higher and lower SES groups from baseline to stage 2 and stage 3. A paired t-test was used to analyse change in the groups over time. Comparative data from questionnaires was analysed using t-tests. Differences between groups in the results section that are statistically significant ($p = < 0.05$) are highlighted. Spearman correlation was used to look for correlations between adult and child fruit and vegetable preferences at baseline and stage 3.

3.8.10 Extreme values

Extreme values found in the SPSS database were cross-matched with data in the WinDiets program and the completed diet diaries. Where no error occurred in entry of data, extreme values were not excluded from the statistical analysis. Extreme values mostly occurred with carotenoid and Vitamin C, where parents and children were reportedly consuming excessive amounts of fruit, fruit juice and carrots.

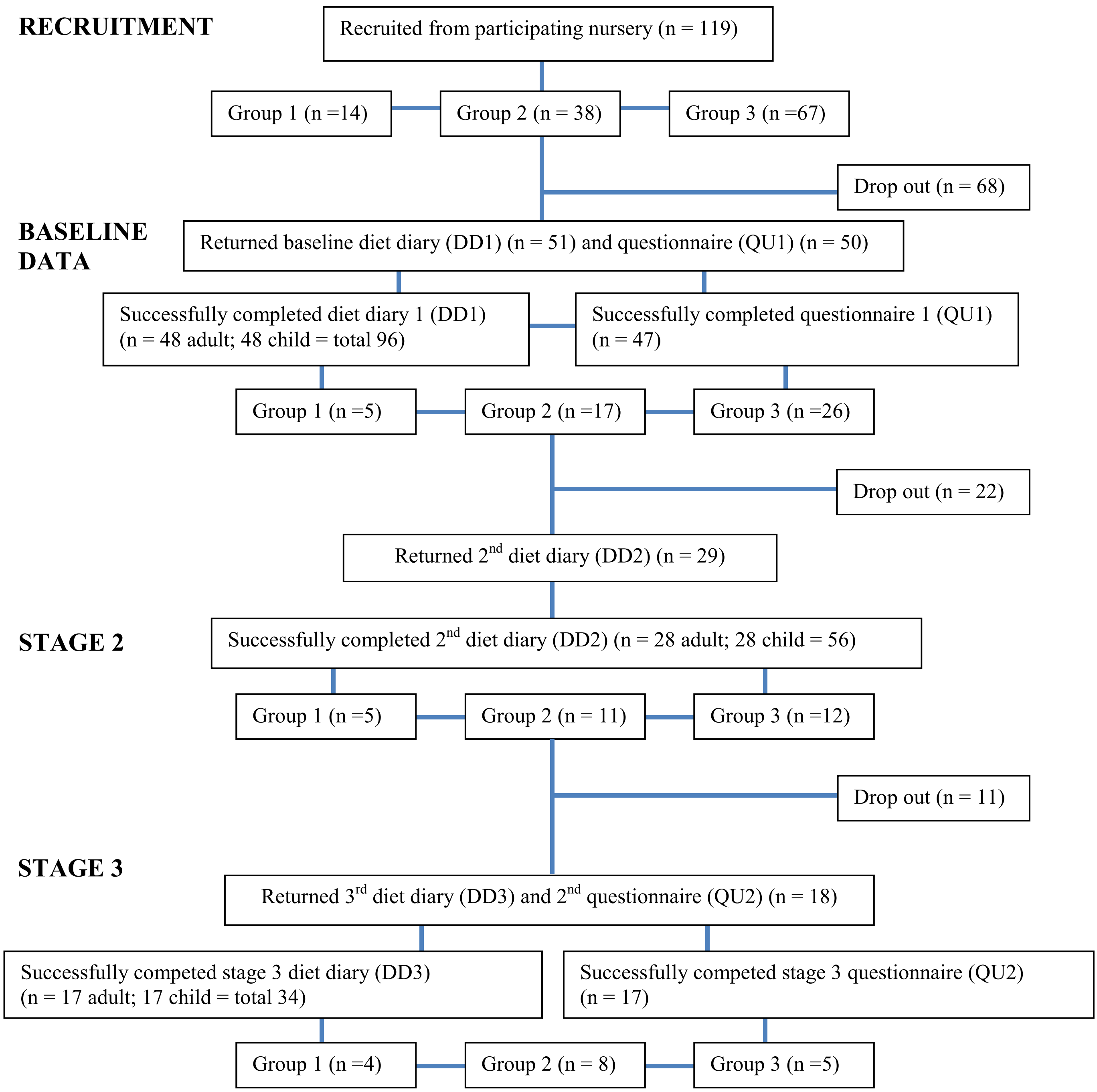
Although some concerns were raised relating to low levels of reported intakes in some participants, this data was not removed from the analysis. Under-reporting is a known concern when gathering data such as this and it is not possible to determine which parents, if not all, under-reported consumption. It is also possible that parents from low socio-economic areas, who are on a limited budget, and particularly those who have multiple children, may be required to reduce their own dietary intake in order to provide for their family.

4 Results; Dietary Intake at Baseline: August 2005

4.1 Sample size

In total, 119 families were recruited from 23 nurseries across the city. The following schematic diagram shows the number of participants who successfully completed the required diet diary (DD) and questionnaire (QU) throughout the research period.

Figure 4.1: Schematic diagram displaying the flow of participants through the study

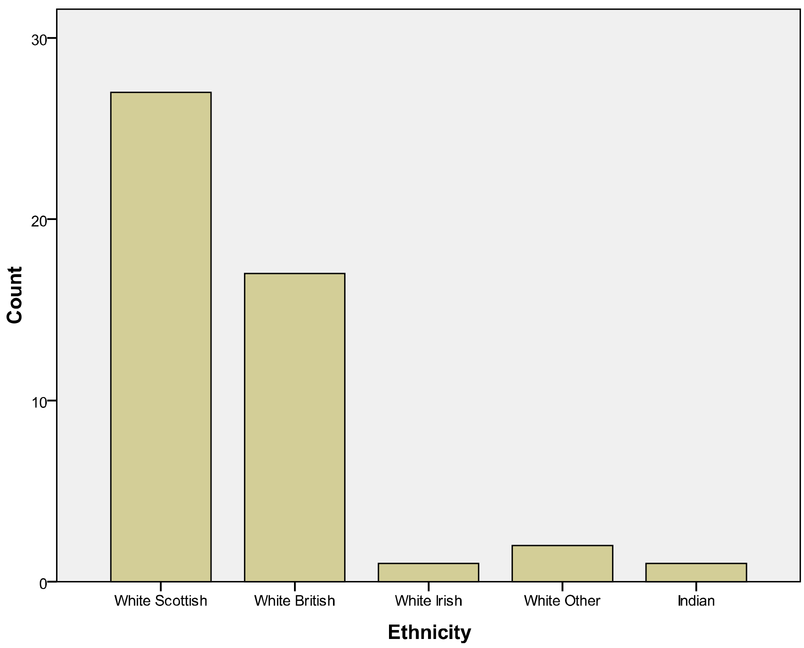


An explanation of the schematic diagram:

'Group 1' represents the 'control group' and 'Group 2' represents the group with minimal intervention. Both Group 1 and Group 2 consist of participants from the 'higher' socio-economic group. 'Group 3' represents the participants from 'lower' socio-economic groups. Of the families who successfully completed the diet diary (DD1) and questionnaire (QU1) at baseline, five families were from intervention 'Group 1', 17 families were from intervention 'Group 2' and 26 families were from intervention 'Group 3' (Figure 4.1). Due to the reduced response rate, the participating families were re-grouped for the purposes of comparative analysis. Participants from Group 1 (n=5) and Group 2 (n=17) were grouped together as 'parents and children from nurseries in higher SES', and compared to group 3 (n=26), 'parents and children from nurseries in lower SES'. However, they have been left segregated in figure 4.1 to demonstrate the initial participation. 'Baseline' represents data collected in August 2005. 'Stage 2' represents data collected 9 months later in June 2006. 'Stage 3' represents data collected in March 2007.

Of the 48 participating children, 28 children were female and 20 were male. The majority of participating children were 'White Scottish' (56 %; n = 27) with the remainder being 'White British', 'Irish' or 'Other' (42 %; n = 20) and one Indian (2 %; n = 1) (see Figure 4.2).

Figure 4.2; Ethnicity of child participants, baseline (DD1[2]):



[2] DD = Diet Diary: DD1 = Diet Diary 1; DD2 = Diet Diary 2; DD3 = Diet Diary 3

4.1.1 Sample data, baseline

Of the 119 parents who agreed to participate in the study, 68 parents did not return the envelope containing the baseline data. Therefore 51 families participated in the baseline phase of the study (43 % response rate). One parent returned the diet diary only and not the questionnaire, meaning that there were 50 questionnaires at baseline, and 3 parents returned incomplete diet diaries, meaning that there were only 48 completed parent diaries and 48 completed child diaries returned (96 diaries in total) for analysis at baseline (please refer to figure 4.1) Overall participation from parents of children from ethnic minority backgrounds was minimal, and two of the families who returned incomplete diet diaries were from ethnic minority backgrounds (Korea and Africa) and spoke English as a second language (ESL), which may signify that the diet diary was too complicated for parents who did not have a reasonable level of English literature and language.

4.1.2 Participant withdrawal

The schematic diagram (4.1) clearly shows participant withdrawal. At stage 2, 29 of the 48 distributed diet diaries were returned (a response rate of 60 %), one of which was discarded, as it was not sufficiently completed. At stage 3, 18 diet diaries and 18 questionnaires were returned (a response rate of 64 %), of which one diary and one questionnaire was discarded, as they were not sufficiently completed. Many reasons were given for withdrawal, including: pregnancy and birth of other children; breakdown of marriage or marital issues; time restraints with family life; diary was too invasive and/or time consuming; moving house; moving away from the area; illness or death in the family.

4.1.3 Completed data

In total for the duration of this study, 96 parent and 96 child diet diaries were completed. Of these, five parent and five child diet diaries were excluded due to insufficient data provided. Therefore 93 parent and 93 child diet diaries were successfully completed, giving a total of 186 five-day diet diaries that were analysed for this study. 50 baseline questionnaires were returned, of which 47 were successfully completed. A further 17 were successfully completed at stage 3 of the study period, making a total of 64 completed questionnaires for analysis.

All results were compared to the United Kingdom Department of Health Dietary Reference Values (DRV's) for Food Energy and Nutrients for the United Kingdom (1991) including the recommended intake for energy (given as Estimated Average Requirement; EAR), macronutrients (CHO, NME sugar, fat and saturated fat as % total energy intake; protein (g/d) and micronutrients (RNI). At the time of this intervention, the EAR for energy for females aged 19 to 50 was 1,940 kcal (8,109 kJ) per day. For comparative data in this research, the guideline that was in place at the time of the research has been used. It is however understood that in 2011, the SACN document Dietary Reference Values for Energy, increased the EAR to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old. The mean of these two recommendations is 2,139 kcal (8,941 kJ).

At baseline, the DRV for children aged 1 to 3 years was used, as all participating children were 3 years old at the time of data collection. In instances where the DRV differed from males to females, the mean DRV was calculated and used. For the longitudinal data, DRV's for children aged 4 to 6 were used, as this was more representative of the age of children attending a council sector nursery.

4.2 Adult diet data analysis (baseline)

Table 4.1 shows that at baseline (August 2005), mean combined intake of fruit and vegetables was 260 g/d which is significantly less ($p = 0.03$) than the recommended intake of 400 g/d. Mean energy intake was 262 kcal below the EAR; CHO and fat was not significantly different to the recommended breakdown of macronutrients (% of total energy intake); saturated fat and NME sugar was marginally higher than the recommended maximum intake (12.6 % total energy compared to 11 % total energy and 13 % total energy compared to 11 % total energy respectively). NSP intake was 6.5 g/d lower than the recommended 18g/d (mean intake of 11.5 g/d). Mean intake of all micronutrients were greater than the RNI with the exception of iron, for which the mean intake was 10.2 mg/g, which is 4.6 mg/d less than the RNI of 14.8 mg/d for adult females aged 19 to 50 years. Reported salt intake was slightly greater than the recommended maximum 6 g/d.

Table 4.1; Mean dietary intake of adults at baseline:

Variable	DRV / guideline	Adult (n = 48)			
		Mean	**St. Dev**	**Min**	**Max**
Fruit intake (g)[3]	-	108.2	79.3	.0	320.6
Veg intake (g)	-	151.9	84.8	2.0	428.0
Total fruit and veg (g)	≥ 400	260.1	139.9	33.0	662.0
Daily portions	≥ 5	3.3	1.7	.4	8.3
Variety fruits	-	4.1	2.8	.0	9.0
Variety veg	-	7.8	3.1	1.0	16.0
Energy intake (kcal/kJ)	~ 1940[4] / ~ 8,109	1,678.9 / 7,018	435 / 1,818	764 /3,193	2,598 /10,859
CHO intake (% of total energy)	~ 50	46.9	5.1	34.8	56.5
NME sugar intake (% of total energy)	≤ 11[5]	13.0	5.0	3.8	27.1
NSP intake (g)	≥ 18	11.5	4.4	4.0	25.2
Fat intake (% of total energy)	~ 35	34.6	4.6	23.4	45.2
Sat fat intake (% of total energy)	≤ 11	12.4	2.2	6.6	16.6
Protein intake (g)	45	64.7	16.2	29.7	99.3
Vitamin A intake (µg)	600	737.5	433.6	218.0	2617.0
Folate intake (µg)	200	221.1	78.3	80.0	420.0
Vit C intake (mg)	40	95.7	62.0	16.7	290.6
Ca intake (mg)	700	767.1	239.2	333.0	1500.0
Fe intake (mg)	14.8	10.2	3.4	3.2	19.5
Zn intake (mg)	7	7.5	2.1	3.3	12.9
Salt intake (g)	< 6	6.1	1.5	2.8	9.3

4.3 Child diet data analysis (baseline)

Table 4.2 shows that at baseline (August 2005), mean combined intake of fruit and vegetables were 203 g/d, of which 79.3 g/d was vegetables. In terms of the Department of Health (DoH) 1991 recommendations, mean energy intake was higher than the EAR; saturated fat and NME sugar was higher than the recommended maximum intake (14.6 %

[3] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

[4] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old.

[5] Guidelines on sugar intake were changed by SACN (2015) from no more than 11 % total energy from NMES to no more than 5 % total energy from 'free sugar'.

of total energy and 17.9 % of total energy respectively). CHO intake from sources other than NME sugar was less than the recommended 39 % energy intake (51.1 % energy intake – 17.9 % intake from NME is 33.2 % energy from CHO).

Table 4.2; Mean dietary intake of children at baseline:

Variable	DRV / guideline	Child (n = 48)			
		Mean	**St. Dev**	**Min**	**Max**
Fruit intake (g)[6]	-	124.7	68.6	.0	279.0
Veg intake (g)	-	79.3	56.7	4.0	256.0
Total fruit and veg (g)[7]	-	203.9	105.7	4.0	535.0
Daily portions	-	2.5	1.3	.1	6.7
Variety fruits	-	5.2	2.8	.0	12.0
Variety veg	-	5.4	2.6	1.0	12.0
Energy intake (kcal/KJ)	1,198 / 5,008	1,405.1 / 606.1	250.1 /1,045.4	1038 / 4,338.9	2111 / 8,824
CHO intake (% of total energy)[8]	39 % not incl. NMES	51.1	4.8	36.2	59.7
NME sugar intake (% of total energy)	-	17.9	5.9	5.8	31.9
NSP intake (g)[9]	-	8.3	2.4	3.0	13.2
Fat intake (% of total energy)	-	34.6	4.3	25.4	44.0
Sat fat intake (% of total energy)	-	14.6	2.7	8.7	21.1
Protein intake (g)	14.5[10]	48.9	9.6	34.4	75.4
Vitamin A intake (µg)	400	576.8	334.6	176.0	2062.0
Folate intake (µg)	70	177.5	60.3	78.0	393.0
Vit C intake (mg)	30	104.9	72.5	26.4	369.9
Ca intake (mg)	350	801.9	252.5	367.0	1461.0
Fe intake (mg)	6.9	7.2	2.0	3.7	13.0
Zn intake (mg)	5	5.2	1.3	2.8	8.8
Salt intake (g)	≤ 2	4.9	1.0	3.1	7.3

Mean intake of protein was 48.9 g/d, which was significantly greater ($p = < 0.05$) than the RNI for children aged 3 years (14.5 g). Mean intake of all micronutrients was greater than the RNI for this age group. Reported salt intake was 4.9 g/d, which is significantly greater than the recommended maximum intake of 2 g/d for children aged 3 years ($p = 0.006$).

[6] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.
[7] There is no established guideline for total fruit and vegetable intake for children
[8] The 1991 DoH guidelines have no EAR for macronutrients as % energy intake other than CHO (39% energy intake not incl. NME sugar) until the age of 5, at which point intake is equal to the adult recommendation.
[9] The 1991 DoH guidelines have no recommended NSP intake for children under the age of 18 years
[10] This is the 1991 DoH RNI for protein (g/d) for children aged 1-3 years

4.4 Comparative adult diet data analysis at baseline (by group)

Table 4.3: Comparative data relating to fruit and vegetable consumption between adults from nurseries in areas of high and low socio-economic status at baseline (nurseries in higher SES n=22; nurseries in lower SES n=26):

	Group at baseline	Mean	St. Dev
Fruit (g) per day [11]	Nurseries in higher SES	140*	79
	Nurseries in lower SES	81	73
Veg (g) per day	Nurseries in higher SES	157.5	62
	Nurseries in lower SES	139	98
Fruit and veg (g) per day combined	Nurseries in higher SES	297.5*	116
	Nurseries in lower SES	219.5	155
Fruit and veg (g) per day compared to WHO recommended intake	Nurseries in higher SES	-102.5*	116
	Nurseries in lower SES	-180	155
Different fruits consumed over 5 day period	Nurseries in higher SES	4.9	2.7
	Nurseries in lower SES	3.4	2.8
Different veg consumed over 5 day period	Nurseries in higher SES	8.9*	3.3
	Nurseries in lower SES	6.9	2.8

***p value = < 0.05**

Table 4.3 compares intakes of fruit and vegetables at baseline between parents in the higher SES group compared to parents in the lower SES group. Fruit intake at baseline by parents from the lower SES group (81 g/d) was significantly lower ($p = 0.01$) than parents from the higher SES group (140 g/d). Total fruit and vegetable intake in the lower SES group was also significantly lower ($p = 0.02$) than the higher SES group (219.5 g/d compared to 297.5 g/d). The variety vegetables consumed was significantly lower in the parents from lower SES group than those from higher SES group ($p = 0.02$).

[11] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 4.4: Comparative data relating to macronutrient intake between adults from nurseries in areas of high and low socio-economic status at baseline (nurseries in higher SES n=22; nurseries in lower SES n=26):

	Group at baseline	Mean	St. Dev
kcal/KJ	Nurseries in higher SES	1,805 / 7,544.9	348.6 / 1,457.1
	Nurseries in lower SES	1,588 / 6,637.8	493.5 / 2,062.8
CHO (% of total energy)	Nurseries in higher SES	47.9	5.2
	Nurseries in lower SES	45.9	5.2
NME sugar (% of total energy)	Nurseries in higher SES	15.2*	3.1
	Nurseries in lower SES	11	2.4
NSP (g) per day	Nurseries in higher SES	11.6	3.3
	Nurseries in lower SES	11.5	5.4
Fat (% of total energy)	Nurseries in higher SES	33.1*	4.7
	Nurseries in lower SES	36	4.4
Saturated fat (% of total energy)	Nurseries in higher SES	11.8	2.3
	Nurseries in lower SES	12.9	2
Protein (g) per day	Nurseries in higher SES	68.6	14.5
	Nurseries in lower SES	61.8	17.7

***p value = < 0.05**

Table 4.4 compares intakes of energy (kcal) and macronutrients (% of total energy from CHO and fat; g/d protein) at baseline between parents in the higher SES group compared to parents in the lower SES group. Parents from the higher SES group consumed significantly higher % of total energy from NME sugar than the lower SES group ($p = 0.005$); 15.2 % energy intake compared to 11 % energy intake by the lower SES group. Parents from the higher SES group consumed significantly less % of total energy from fat ($p = 0.04$). There were no other significant differences between the higher and lower SES groups.

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Table 4.5: Comparative data relating to micronutrient intake between adults from nurseries in areas of high and low socio-economic status at baseline (nurseries in higher SES n=22; nurseries in lower SES n=26):

	Group at baseline	**Mean**	**St. Dev**
Vitamin A (µg) per day	Nurseries in higher SES	666.6	292.7
	Nurseries in lower SES	793	528.1
Folate (µg) per day	Nurseries in higher SES	233	82
	Nurseries in lower SES	212	78
Vitamin C (mg) per day	Nurseries in higher SES	101.4	58.6
	Nurseries in lower SES	92.8	67.4
Calcium (mg) per day	Nurseries in higher SES	816.5	246.4
	Nurseries in lower SES	714	235
Iron (mg) per day	Nurseries in higher SES	11.4	3.2
	Nurseries in lower SES	9.3	3.4
Zinc (mg) per day	Nurseries in higher SES	7.9	1.6
	Nurseries in lower SES	7.1	2.6
Salt (g) per day	Nurseries in higher SES	6.3	1.3
	Nurseries in lower SES	6	1.8

***p value = < 0.05**

Table 4.5 compares intakes of micronutrients at baseline between parents from the higher SES group compared to parents from the lower SES group. There was no significant difference in intake of any micronutrient between groups. All intakes were greater than the RNI for adult females aged 19 to 50 years with the exception of iron which was lower than the recommended 14.8 mg/d. Mean intake of iron was lower in the lower SES group (9.3 g/d compared to 11.4 g/d in the higher SES group).

4.5 Comparative child diet data analysis at baseline (by group)

Table 4.6: Comparative data relating to fruit and vegetable consumption between children from nurseries in areas of high and low socio-economic status at baseline (nurseries in higher SES n=22; nurseries in lower SES n=26):

	Group SES	Mean	St. Dev
Fruit (g) per day [12]	Nurseries in higher SES	135	75
	Nurseries in lower SES	116	63
Veg (g) per day	Nurseries in higher SES	87	48
	Nurseries in lower SES	73	63
Fruit and veg (g) per day combined	Nurseries in higher SES	222	96
	Nurseries in lower SES	189	113
Different fruits consumed over 5 day period	Nurseries in higher SES	5.7	3.1
	Nurseries in lower SES	4.7	2.4
Different veg consumed over 5 day period	Nurseries in higher SES	6.3*	2.8
	Nurseries in lower SES	4.7	2.2

***p value = < 0.05**

Table 4.6 compares intakes of fruit and vegetables at baseline between children from the higher SES group compared to children from the lower SES group. There was no significant difference in intakes of fruit or vegetables at baseline. Children from the lower SES group consumed significantly fewer vegetables in terms of variety (p = 0.03) than children from higher SES at baseline (4.7 items compared to 6.3 items).

[12] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 4.7: Comparative data relating to macronutrient consumption between children from nurseries in areas of high and low socio-economic status at baseline (nurseries in higher SES n=22; nurseries in lower SES n=26):

	Group SES	Mean	St. Dev
kcal/KJ	Nurseries in higher SES	1,406 / 5,877	217 / 907
	Nurseries in lower SES	1404 / 5,868	280 / 1,170
CHO (% of total energy)	Nurseries in higher SES	52.3	4.8
	Nurseries in lower SES	50.1	4.6
NME sugar (% of total energy)	Nurseries in higher SES	19.5	5
	Nurseries in lower SES	16.6	6.4
NSP (g) per day	Nurseries in higher SES	8.9	1.9
	Nurseries in lower SES	7.8	2.7
Dietary fat (% of total energy)	Nurseries in higher SES	33.6	4.7
	Nurseries in lower SES	35.6	3.7
Saturated fat (% of total energy)	Nurseries in higher SES	13.8	3.0
	Nurseries in lower SES	15.3	2.2
Protein (g) per day	Nurseries in higher SES	48.7	8.5
	Nurseries in lower SES	49.1	10.7

***p value = < 0.05**

Table 4.7 compares intakes of energy (kcal/d) and macronutrients (% of total energy) at baseline between children from the higher SES group compared to children from the lower SES group. Energy intake in both groups was higher than the EAR. There was no significant difference in intakes of energy or macronutrients between groups. Intakes of NME sugar and saturated fat were greater than the recommended upper limit in both groups, with higher intakes of NME sugar in the higher SES group (19.5 % compared to 16.6 %) and higher intakes of saturated fat in the lower SES group (15.3 % compared to 13.8 %). Protein intakes (g/d) were significantly greater than the RNI in both groups ($p = < 0.05$).

Table 4.8: Comparative data relating to micronutrient consumption between children from nurseries in areas of high and low socio-economic status at baseline (nurseries in higher SES n=22; nurseries in lower SES n=26):

	Group SES	Mean	St. Dev
Vitamin A (µg) per day	Nurseries in higher SES	570.8	252.6
	Nurseries in lower SES	581.8	396
Folate (µg) per day	Nurseries in higher SES	168.6	44
	Nurseries in lower SES	185	71.3
Vitamin C (mg) per day	Nurseries in higher SES	107.1	60.8
	Nurseries in lower SES	103	82.3
Calcium (mg) per day	Nurseries in higher SES	795.4	229.1
	Nurseries in lower SES	807.3	275
Iron (mg) per day	Nurseries in higher SES	7.2	1.9
	Nurseries in lower SES	7.2	2.1
Zinc (mg) per day	Nurseries in higher SES	5.3	1.1
	Nurseries in lower SES	5.2	1.4
Salt (g) per day	Nurseries in higher SES	5.2	1.0
	Nurseries in lower SES	4.9	1.0

***p value = < 0.05**

Table 4.8 compares intakes of micronutrients at baseline between children from the higher SES group compared to children from the lower SES group. There was no significant difference in mean intake of any micronutrients between groups. Mean intake of all micronutrients was greater than the RNI. Folate intake in the higher SES group was significantly greater than the RNI ($p = 0.04$). Salt intakes in both groups were significantly greater than the recommended maximum intake of 2 g/d for children aged 3 years in both the lower SES group ($p = 0.009$) and the higher SES group ($p = 0.010$).

5 Results; Dietary intake: August 2005 to June 2006

Parents who had not completed the baseline diet diary were excluded from stage 2 of the study (see section 4). In June 2006 a 2nd diet diary was distributed to the remaining families to identify changes to dietary intake. There were a total of 28 adults and 28 child returned useable diet diaries. Analysis was carried out to compare the change in dietary intake of children and parents from the two intervention groups (see schematic diagram 4.1), and to compare intake in the group as a whole, from baseline to stage 2.

Table 5.1: Comparative data relating to fruit and vegetable consumption between all adult participants at baseline and stage 2 (n=28):

	Stage	Mean	St. Dev
Fruit (g) per day [13]	Baseline	103	80
	Stage 2	96	76
Veg (g) per day	Baseline	155	70
	Stage 2	150	78
Fruit and veg (g) per day combined	Baseline	258	114
	Stage 2	246	133
Fruit and veg (g) per day compared to WHO recommended intake	Baseline	-142	114
	Stage 2	-154	133
Different fruits consumed over 5 day period	Baseline	3.8	2.7
	Stage 2	4.0	2.6
Different veg consumed over 5 day period	Baseline	8.4	3.2
	Stage 2	7.7	3.1

*** p value = < 0.05**

Table 5.1 shows the difference in intake of fruit and vegetables in parents from both groups from baseline (August 2005) to stage 2 (June 2006). There was no significant change in intake over time in intake of fruit or vegetables in terms of g/d or variety consumed.

[13] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 5.2: Comparative data relating to macronutrient consumption between all adult participants at baseline and stage 2 (n=28):

	Stage	Mean	St. Dev.
kcal / kJ	Baseline	1621 / 6,782	409.2 / 1,712
	Stage 2	1601 / 6,698	463.6 / 1,940
CHO (% of total energy)	Baseline	46.7	5.2
	Stage 2	45.4	7.2
NME sugar (% of total energy)	Baseline	13.2	5.6
	Stage 2	12.1	4
NSP (g) per day	Baseline	10.6	3.2
	Stage 2	11.6	3.4
Overall dietary fat (% of total energy)	Baseline	34.9	4.4
	Stage 2	35	6.1
Saturated fat (% of total energy)	Baseline	12.7	2.4
	Stage 2	12.5	2.6
Protein (g) per day	Baseline	62.7	16
	Stage 2	61.1	16.6

*** p value = < 0.05**

Table 5.2 shows the difference in intake of energy and macronutrients in parents from both groups from baseline (August 2005) to stage 2 (June 2006). There was no significant change in intake of energy or macronutrients over time.

Table 5.3: Comparative data relating to micronutrient consumption between all adult participants at baseline and stage 2 (n=28):

	Stage	Mean	St. Dev
Vitamin A (µg) per day	Baseline	737.5	357.2
	Stage 2	769.8	379.3
Folate (µg) per day	Baseline	213	69.4
	Stage 2	203	68.8
Vitamin C (mg) per day	Baseline	93.8	52.1
	Stage 2	90.4	60.5
Calcium (mg) per day	Baseline	732.9	216.8
	Stage 2	782.6	318.8
Iron (mg) per day	Baseline	9.7	2.8
	Stage 2	9.5	3.5
Zinc (mg) per day	Baseline	7.1	1.9
	Stage 2	7.4	2.5
Salt (g) per day	Baseline	5.7	1.2
	Stage 2	5.8	1.9

*** p value = < 0.05**

Table 5.3 shows the difference in intake of micronutrients in parents from both groups from baseline (August 2005) to stage 2 (June 2006). There was no significant change in intake of macronutrients over time.

Table 5.4: Comparative data relating to fruit and vegetable consumption between adult participants at baseline and stage 2 by socio-economic status (nurseries in higher SES n=16; nurseries in lower SES n=12):

		Baseline		Stage 2		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Fruit per day (g) [14]	Nurseries in higher SES	134.5	86.3	127.6	77.9	-6.9	80.0
	Nurseries in lower SES	61.1*	47.6	61.3*	57.5	0.2	47.0
Veg per day (g)	Nurseries in higher SES	178.6	65.2	181.1	75.4	2.5	56.5
	Nurseries in lower SES	124.5*	67.1	105.8*	60.7	-18.7	62.3
Fruit and veg (g) per day	Nurseries in higher SES	313.1	110.6	308.7	120.5	-4.4	106.4
	Nurseries in lower SES	185.6*	72.7	167*	106.1	-18.5	77.5
Fruit and veg per day (g) compared to WHO recommended intake	Nurseries in higher SES	-86.9	110.6	-91.3	120.5	N/A	N/A
	Nurseries in lower SES	-214.4*	72.7	-233*	106.1		
Different fruits consumed over 5 day period	Nurseries in higher SES	4.7	2.8	4.8	2.4	0.06	2.2
	Nurseries in lower SES	2.6*	2.1	3.0	2.6	0.42~	1.0
Different veg consumed over 5 day period	Nurseries in higher SES	9.6	2.8	8.5	2.2	-1.06	2.4
	Nurseries in lower SES	6.8*	3.1	6.3	3.6	-0.4	3.0

*** p value = < 0.05: significant difference between higher and lower SES group at set time**

~ p value = < 0.05: significant difference in change between higher and lower SES groups over time

Table 5.4 shows the difference in intake of fruit and vegetables in parents from the higher SES group compared to parents from the lower SES group from baseline (August 2005) to stage 2 (June 2006). At baseline, fruit intake was 134.5 g/d in the higher SES group compared to 61.1 g/d in the lower SES group (p = 0.02). This was similar to the findings at stage 2, with intake of 127.6 g/d in the higher SES group compared to 61.3 in the lower SES group (p = 0.02). There was also a significant difference in the vegetables consumed at baseline, with 178.6 g/d consumed by the higher SES group compared to 124.5 g/d consumed by the lower SES group (p = 0.03) and stage 2, with 181.1 g/d consumed by the higher SES group compared to 105.8 g/d consumed by the lower SES group (p = 0.04).

Intake of fruit and vegetables combined (g/d) was significantly greater (p = < 0.05) in the higher SES group at both baseline (313.1 g/d compared to 185.6 g/d) and stage 2 (308.7 g/d compared to 167 g/d). The variety of fruit and vegetables was significantly lower in

[14] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

the lower SES group at baseline (fruit: 4.7 compared to 2.6 items; vegetables: 9.6 compared to 6.8 items). There was a significant difference in the change in the variety of fruits between the two groups (p = < 0.045) from baseline to stage 2, which was due to an increase of 0.4 pieces (from 2.6 pieces to 3 pieces) in the lower socio-economic group and no change in the higher SES group. At each stage of the Pip study, intake was lower in parents from the lower SES group.

Table 5.5: Comparative data relating to macronutrient consumption between adult participants at baseline and stage 2 by socio-economic status (nurseries in higher SES n=16; nurseries in lower SES n=12):

		Baseline		Stage 2		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
kcal /KJ	Nurseries in higher SES	1,808 / 7,564	354 / 1,481	1,721 / 7,200	453 / 1,895	-86.3	345.5
	Nurseries in lower SES	1,372* / 5,740*	349 / 1,460	1,440 / 6,024	446 / 1,866	67.8	304.0
CHO (% of total energy)	Nurseries in higher SES	47.2	5.2	46	7.4	-1.1	7.1
	Nurseries in lower SES	46	5.3	44.5	7.1	-4.1	7.0
NME sugar (% of total energy)	Nurseries in higher SES	15	5	13.2	3.9	-1.7	6.4
	Nurseries in lower SES	10.9*	5.6	10.6*	3.9	-0.3	5.1
NSP (g) per day	Nurseries in higher SES	11.2	2.8	12.5	2.6	1.3	2.2
	Nurseries in lower SES	9.8	3.5	10.3	4.1	0.5	3.0
Fat (% of total energy)	Nurseries in higher SES	34.1	4.3	34.0	5.8	-0.1	4.6
	Nurseries in lower SES	36.1	4.4	36.5	6.5	0.5~	9.1
Saturated fat (% of total energy)	Nurseries in higher SES	12.3	2.5	11.9	1.9	-0.3	2.4
	Nurseries in lower SES	13.2	2.2	13.3	3.3	0.1	1.6
Protein (g)	Nurseries in higher SES	69.1	15.1	66.0	13.1	-3.1	13.4
	Nurseries in lower SES	54.1*	13.4	59.9	18.6	5.7	9.8

*** p value = < 0.05: significant difference between higher and lower SES group at set time**

~ p value = < 0.05: significant difference in change between higher and lower SES groups over time

Table 5.5 shows the difference in intake of energy and macronutrients in parents from the higher SES group compared to parents from the lower SES group from baseline (August 2005) to stage 2 (June 2006). Mean intake of kcal was significantly greater (p = 0.02) in the higher SES group at baseline (1,808 kcal (7,564 kJ) compared to 1,372 kcal (5,740 kJ)); however by stage 2 there was no significant difference in intake due to an increase in mean energy intake from the lower SES group and a decrease in mean energy intake from the higher SES group. Mean intake of NME sugar (% of total energy) was significantly greater (p = < 0.05) in the higher SES group both at baseline and at stage 2. Mean intake of protein (g/d) was significantly greater in higher SES group at baseline (p = 0.04); there was no significant difference by stage 2 due to a marginal increase in intake in the lower SES group and a marginal decrease in intake in the higher SES group.

Table 5.6: Comparative data relating to micronutrient consumption between adult participants at baseline and stage 2 by socio-economic status (nurseries in higher SES n=16; nurseries in lower SES n=12):

		Baseline		Stage 2		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Vitamin A (μg) per day	Nurseries in higher SES	723.9	310.8	816.1	396.9	92.1	308.7
	Nurseries in lower SES	755.7	425.2	655.1	279.7	-100.6~	535.8
Folate (μg) per day	Nurseries in higher SES	228.4	72.9	221.4	59.9	-7.0	60.8
	Nurseries in lower SES	192.7	61.4	203.9	85.5	11.2	60.2
Vitamin C (mg) per day	Nurseries in higher SES	103.9	48.5	107.3	55.6	3.3	58.3
	Nurseries in lower SES	80.3	55.8	70.2	48.8	-10.2	38.5
Calcium (mg) per day	Nurseries in higher SES	812.9	233.0	847.8	318.5	34.8	258.5
	Nurseries in lower SES	626.3	140.1	696.8	203.8	70.6	149.0
Iron (mg) per day	Nurseries in higher SES	11.1	2.3	10.2	2.9	-0.8	2.8
	Nurseries in lower SES	7.9*	2.5	8.5	3.1	0.5	2.5
Zinc (mg) per day	Nurseries in higher SES	7.9	1.7	7.8	1.8	-0.13	1.8
	Nurseries in lower SES	6.0*	1.6	7.3	2.8	1.4	2.7
Salt (g) per day	Nurseries in higher SES	6.2	1.1	6.3	2.0	0.1	1.8
	Nurseries in lower SES	5.1	1.1	5.2	1.6	0.12	1.3

***p value= < 0.05: significant difference between higher and lower SES group at set time**

~ p value = < 0.05: significant difference in change between higher and lower SES groups over time

Table 5.6 shows the difference in intake of micronutrients in parents from the higher SES group compared to parents from the lower SES group from baseline (August 2005) to stage 2 (June 2006). There was a significant difference (p = < 0.05) in the change over time of intake of Vitamin A, due to a decrease in mean intake from the lower SES group and an increase in mean intake from the higher SES group. There was a significant difference in mean iron intake (p = 0.05) between the higher SES and lower SES groups at baseline (11.1 mg/d compared to 7.9 mg/d). By stage 2, intakes in the lower SES group had increased to 8.5 mg/d and intakes in the higher SES group had decreased to 10.2

mg/d meaning the difference was no longer significant. Mean intake of iron was lower than the RNI (14.8 mg/d) at baseline and stage 2 in both groups. Mean intake of zinc in the lower SES group was lower than the RNI (7 mg/d) and significantly lower ($p = 0.05$) than the mean intake of the higher SES group at baseline (7.9 mg/d in the higher SES group compared to 6 mg/d in the lower SES group); there was no significant difference between groups by stage 2, and mean intakes in both groups were just above the RNI. Mean intake of folate was below the RNI (200 µg/d) in the lower SES group at baseline; by stage 2 the mean intake was above the RNI.

Table 5.7: Comparative data relating to fruit and vegetable consumption between all child participants at baseline and stage 2 (n=28):

	Stage	Mean	St. Dev
Fruit (g) per day [15]	Baseline	125.5	73
	Stage 2	137	78
Veg (g) per day	Baseline	77	48
	Stage 2	97	66
Fruit and veg (g) per day	Baseline	203	97
	Stage 2	235	115
Different fruits consumed over 5 day period	Baseline	5.1	3.0
	Stage 2	4.9	2.3
Different veg consumed over 5 day period	Baseline	5.6	2.5
	Stage 2	5.6	2.9

***p value = < 0.05**

Table 5.7 shows the difference in mean intake of fruit and vegetables in all children from baseline (August 2005) to stage 2 (June 2006). There is no significant change in intake over time.

[15] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 5.8: Comparative data relating to macronutrient consumption between all child participants at baseline and stage 2 (n=28):

	Stage	Mean	Std. Dev.
kcal / kJ	Baseline	1,416 / 5,925	221 / 925
	Stage 2	1,462 / 6,117	279 / 1,167
CHO (% of total energy)	Baseline	51.0	5.3
	Stage 2	50.0	4.2
NME sugar (% of total energy)	Baseline	18.1	5.9
	Stage 2	17.4	4.2
NSP (g) per day	Baseline	8.7	2.2
	Stage 2	9.1	2.2
Fat (% of total energy)	Baseline	34.5	4.8
	Stage 2	35.2	3.8
Saturated fat (% of total energy)	Baseline	14.6	2.7
	Stage 2	14.6	2.3
Protein (g) per day	Baseline	50.1	8.7
	Stage 2	53.5	11.6

***p value = < 0.05**

Table 5.8 shows the difference in intake of energy and macronutrients in children from baseline (August 2005) to stage 2 (June 2006). There is no significant change in intake over time. Mean intake of NME sugar and saturated fat is greater than the recommended maximum intake at both stages.

Table 5.9; Comparative data relating to macronutrient consumption between all child participants at baseline and stage 2 (n=28):

	Stage	Mean	Std. Dev
Vitamin A (μg) per day	Baseline	550.5	227.6
	Stage 2	592.8	244.9
Folate (μg) per day	Baseline	176.6	53.6
	Stage 2	176.5	48.6
Vitamin C (mg) per day	Baseline	111.8	80.4
	Stage 2	106.7	43.8
Calcium (mg) per day	Baseline	792.8	215.8
	Stage 2	826.3	291.4
Iron (mg) per day	Baseline	7.4	1.9
	Stage 2	7.5	2.0
Zinc (mg) per day	Baseline	5.4	1.2
	Stage 2	6.2	1.8
Salt (g) per day	Baseline	5.0	.87
	Stage 2	5.4	1.4

***p value = < 0.05**

Table 5.9 shows the difference in mean intake of micronutrients in children from baseline (August 2005) to stage 2 (June 2006). There was no significant change in intake over time. Mean intakes of all micronutrients were greater than the RNI at both stages. Intakes of salt were greater than the recommended maximum 2 g/d for children aged 3 years at baseline and greater than the recommended maximum 3 g/d for children aged 4 years at stage 2.

Table 5.10: Comparative data relating to fruit and vegetable consumption between child participants at baseline and stage 2 by socio-economic status (nurseries in higher SES n=16; nurseries in lower SES n=12):

		Baseline		Stage 2		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Fruit per day (g) [16]	Nurseries in higher SES	139	82	150	83	11.2	83.5
	Nurseries in lower SES	107	57	120	72	12.8	64.3
Veg per day (g)	Nurseries in higher SES	84	49	105	77	20.9	78.4
	Nurseries in lower SES	68	47.5	86.5	49	18.7	45.1
Fruit and veg (g) per day	Nurseries in higher SES	224	100	256	118	32.1	96.6
	Nurseries in lower SES	175	90	207	110	31.5	89.7
Different fruits consumed over 5 day period	Nurseries in higher SES	5.9	3.4	4.9	2.4	-1.0	N/A
	Nurseries in lower SES	4.2	2.3	4.9	2.3	0.67	
Different veg consumed over 5 day period	Nurseries in higher SES	6.3	2.2	6.2	2.8	-0.1	2.78
	Nurseries in lower SES	4.8	2.7	4.9	3.1	0.17	2.42

***p value = < 0.05: significant difference between higher and lower SES group at set time**

Table 5.10 shows the difference in intake of fruit and vegetables in children from the higher SES group compared to children from the lower SES group from baseline (August 2005) to stage 2 (June 2006). There was no significant difference in mean intake of fruit or vegetables, in terms of gram or variety, at baseline or stage 2, and no significant difference in terms of change in intake over time, although marginal increases over time were observed in both SES groups.

[16] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 5.11: Comparative data relating to macronutrient consumption between child participants at baseline and stage 2 by socio-economic status (nurseries in higher SES n=16, nurseries in lower SES n=12):

		Baseline		Stage 2		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Kcal/KJ	Nurseries in higher SES	1,456 / 6,091	219 / 916	1,483 / 6,205	329 / 1,377	27.1	317.5
	Nurseries in lower SES	1,363 / 5,703	221 / 925	1,435 / 6,004	206 / 862	72.3	223.9
CHO (% of total energy)	Nurseries in higher SES	52.5	4.7	50.8	4.1	-1.73	5.27
	Nurseries in lower SES	48.8*	5.6	48.9	4.2	0.05	4.77
NME sugar (% of total energy)	Nurseries in higher SES	20.1	5.0	18.3	3.2	-1.74	4.7
	Nurseries in lower SES	15.5*	6.1	16.3	5.1	0.8	4.2
NSP (g) per day	Nurseries in higher SES	9.3	1.6	9.4	1.9	0.09	2.56
	Nurseries in lower SES	7.8	2.7	8.7	2.6	0.83	2.23
Fat (% of total energy)	Nurseries in higher SES	33.3	4.9	34.8	3.5	1.4	4.9
	Nurseries in lower SES	36.0	4.4	35.7	4.2	-0.3	3.3
Saturated fat (% of total energy)	Nurseries in higher SES	14.0	3.0	14.0	1.7	0	2.6
	Nurseries in lower SES	15.4	2.0	15.4	2.8	0	3.6
Protein (g) per day	Nurseries in higher SES	50.1	8.8	52.3	12.1	2.2	14.3
	Nurseries in lower SES	50.2	9.0	55.0	11.2	4.8	9.9

***p value = < 0.05: significant difference between higher and lower SES group at set time**

Table 5.11 shows the difference in mean intake of energy and macronutrients in children from the higher SES group compared to children from the lower SES group from baseline (August 2005) to stage 2 (June 2006). At baseline, children from the higher SES consumed significantly more CHO ($p = 0.05$) (52.5 % energy from CHO in the higher SES group compared to 48.8 % in the lower SES group) and significantly more NME sugar ($p = 0.038$) at baseline with a mean intake of 20.1 % energy intake from NME sugar, compared to a mean intake of 15.5 % energy intake from NME sugar in the lower SES group. By stage 2, there was no significant difference in intake, due to a decrease in mean intake in children from the higher SES group and an increase in mean intake in children from the lower SES group over time. There were no other significant differences in intakes between groups over time.

Table 5.12: Comparative data relating to micronutrient consumption between child participants at baseline and stage 2 by socio-economic status (nurseries in higher SES n=16; nurseries in lower SES n=12):

		Baseline		Stage 2		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Vitamin A (µg) per day	Nurseries in higher SES Nurseries in lower SES	559.7 538.2	209.6 258.6	588.5 598.4	233.3 270.0	28.8 60.3~	216.1 413.0
Folate (µg) per day	Nurseries in higher SES Nurseries in lower SES	169.7 185.8	40.0 68.6	175.0 178.6	41.1 59.2	5.3 -7.2	54.0 55.5
Vitamin C (mg) per day	Nurseries in higher SES Nurseries in lower SES	114.9 107.8	67.0 98.5	113.9 97.1	42.1 46.0	-0.9 -10.7	41.6 81.8
Calcium (mg) per day	Nurseries in higher SES Nurseries in lower SES	798.1 785.8	211.9 230.2	824.3 829.0	318.5 264.7	26.1 43.3	299.3 202.7
Iron (mg) per day	Nurseries in higher SES Nurseries in lower SES	7.6 7.1	1.9 1.9	7.8 7.1	2.0 2.0	0.17 0.07	2.2 1.7
Zinc (mg) per day	Nurseries in higher SES Nurseries in lower SES	5.5 5.2	1.2 1.3	5.9 6.7†	1.8 1.8	0.3 1.4	1.8 1.5
Salt (g) per day	Nurseries in higher SES Nurseries in lower SES	4.9 5.1	1.0 0.7	5.5 5.3	1.7 1.1	0.53 0.15	1.48 0.83

***p value = < 0.05: significant difference between higher and lower SES group at set time**

† p value = < 0.05 (longitudinal statistics)

~ p value = < 0.05: significant difference in change between higher and lower SES groups over time

Table 5.12 shows the difference in mean intake of micronutrients in children from the higher SES group compared to children from the lower SES group from baseline (August 2005) to stage 2 (June 2006). There was a significant difference ($p = < 0.04$) in the change over time of Vitamin A, with children from the lower SES group increasing their intake by 60.3 µg/d compared to children from the higher SES group, who increased intake by 28.8 g/d. There was a significant difference ($p = < 0.04$) in intake of zinc over time in the lower SES group from 5.2 mg/d to 6.7 mg/d. Intakes of micronutrients were greater than the RNI at all times in both groups. Intakes of salt were greater than the recommended maximum 2 g/d for children aged 3 years at baseline and greater than the recommended maximum 3 g/d for children aged 4 years at stage 2 in both groups.

6 Results; Dietary Intake: August 2005 and March 2007

Parents who had not completed the stage 2 diet diaries (DD2) were excluded from stage 3 of the study (see section 4.1). Of the 29 families who had returned the stage-2 diet diaries, 18 returned the stage 3 diet diaries and questionnaire. One diet diary was not completed sufficiently, and was discarded. Therefore 17 parent and 17 child diet diaries were successfully completed and used for analysis at stage 3 of the study. One parent had not sufficiently completed the 2nd questionnaire, meaning that there were 17 questionnaires available for analysis at stage 3 of the study. Analysis was carried out to compare the change in dietary intake of children and parents from the two intervention groups (see schematic diagram 4.1), and to compare intake in the group as a whole, from baseline to stage 3. As 12 families from the higher SES group and 5 from the lower SES group remained, this may have impacted on the statistical significance of results.

Table 6.1: Comparative data relating to fruit and vegetable consumption between all adult participants at baseline and stage 3 (n=17):

	Stage	Mean	St. Dev.
Fruit (g) per day[17]	Baseline	118	85
	Stage 3	147	87
Vegetable (g) per day	Baseline	161.5	67
	Stage 3	175	85
Fruit and vegetable (g) per day	Baseline	279	119
	Stage 3	320	116
Fruit and vegetable (g) compared to WHO recommended intake	Baseline	-121	119
	Stage 3	-80	116
Different fruits consumed over 5 day period	Baseline	4.1	3.0
	Stage 3	4.6	2.8
Different vegetables consumed over 5 day period	Baseline	9.1	3.4
	Stage 3	8.7	3.3

***p value = < 0.05**

Table 6.1 shows the difference in intake of fruit and vegetables by parents from baseline (August 2005) to stage 3 (April 2007). There was no significant difference in mean intakes of fruit and vegetables over this time period in the group as a whole.

[17] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 6.2: Comparative data relating to macronutrient consumption between all adult participants at baseline and stage 3 (n=17):

	Stage	Mean	St. Dev.
kcal / kJ	Baseline	1,768 / 7,397	389 / 1,628
	Stage 3	1,824 / 7,332	544 / 2,276
CHO (% of total energy)	Baseline	46.0	5.8
	Stage 3	44.2	6.3
NME sugar (% of total energy)	Baseline	14.7	5.8
	Stage 3	11.8	4.3
NSP (g) per day	Baseline	10.7*	3.0
	Stage 3	14.0	4.3
Fat (% of total energy)	Baseline	34.8	4.7
	Stage 3	36.9	5.0
Saturated fat (% of total energy)	Baseline	12.5	2.7
	Stage 3	14.0	2.1
Protein (g) per day	Baseline	67.7	14.0
	Stage 3	69.4	14.2

***p value = < 0.05**

Table 6.2 shows the difference in intake in energy and macronutrients by parents from baseline (August 2005) to stage 3 (April 2007). There was a significant increase (p = < 0.05) in NSP (g/d) over time (10 g/d at baseline to 14 g/d at stage 3) but intakes did not meet the recommended minimum 18 g/d by stage 3. There were no other significant differences noted. Intake of energy was less than the EAR at both stages. Intakes of NME sugar (% energy intake) decreased over time but were still greater than the recommended maximum intake (≤ 11 % total energy intake). Saturated fat intakes increased over time and were greater than the recommended maximum intake (≤ 11 % total energy intake) at both stages.

Table 6.3: Comparative data relating to micronutrient consumption between all adult participants at baseline and stage 3 (n=17):

	Stage	Mean	St. Dev.
Vitamin A (µg) per day	Baseline	740	264
	Stage 3	899	345
Folate (µg) per day	Baseline	222.3	65.8
	Stage 3	248.5	77.9
Vitamin C (mg) per day	Baseline	100.7	48.7
	Stage 3	111.3	67.0
Calcium (mg) per day	Baseline	749.8	264.8
	Stage 3	794.9	257.9
Iron (mg) per day	Baseline	10.4	2.5
	Stage 3	11.7	5. 3
Zinc (mg) per day	Baseline	7.5	2.0
	Stage 3	7.9	1.9
Salt (g) per day	Baseline	5.9	1.2
	Stage 3	6.5	1.7

***p value = < 0.05**

Table 6.3 shows the difference in mean intake of micronutrients by parents from baseline (August 2005) to stage 3 (April 2007). There was no significant change in mean intakes of micronutrients over this time period in the group as a whole. Intakes of iron were less than the RNI (14.8 mg/d) at both stages. Reported salt intake was greater than the recommended maximum intake of 6 g/d by stage 3.

Table 6.4: Comparative data relating to fruit and vegetable consumption between adult participants at baseline and stage 3 by socio-economic status (nurseries in higher SES n=12; nurseries in lower SES n=5):

		Baseline		Stage 3		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Fruit per day (g) [18]	Nurseries in higher SES	132	93.5	165	79	30.7	97.1
	Nurseries in lower SES	82	50.5	100.5	96.5	18.2	104.7
Vegetable per day (g)	Nurseries in higher SES	177	50	190	87	13.4	77.8
	Nurseries in lower SES	124	92	134	71	10.0	35.6
Fruit and vegetable (g) per day	Nurseries in higher SES	309	118	355	93.5	45.1	104.8
	Nurseries in lower SES	206.5	96	234.5*	131.5	28.2	124.4
Fruit and vegetable per day (g) compared to WHO recommended intake	Nurseries in higher SES	-91	118	-45	94	N/A	N/A
	Nurseries in lower SES	-194	96	-165*	132		
Different fruits consumed over 5 day period	Nurseries in higher SES	4.7	3.2	4.9	2.9	0.2	2.3
	Nurseries in lower SES	2.6	1.8	3.8	2.6	1.2	2.8
Different vegetable consumed over 5 day period	Nurseries in higher SES	10	2.6	9.4	2.9	-0.4	3.2
	Nurseries in lower SES	6.8	4.3	7.0	3.9	0.2~	1.1

***p value = < 0.05: significant difference between higher and lower SES group at set time**

~ p value = <0.05: significant difference in change between higher and lower SES groups over time

Table 6.4 shows the difference in mean intake of fruit and vegetables from baseline (August 2005) to stage 3 (April 2007) of parents from the higher SES group compared to parents from the lower SES group. Mean intake of combined fruit and vegetables was lower in the lower SES group at both stages and significantly lower ($p = 0.05$) at stage 3 (355 g/d compared to 234.5 g/d). There was a significant difference ($p = 0.05$) in the change over time in variety of vegetables consumed by the lower SES group compared to the higher SES group, due to a marginal decrease in variety consumed by the higher SES group and a marginal increase in variety consumed by the lower SES group.

[18] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 6.5: Comparative data relating to macronutrient consumption between adult participants at baseline and stage 3 by socio-economic status (nurseries in higher SES n=12; nurseries in lower SES n=5):

		Baseline		**Stage 3**		**Change over time**	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Kcal/KJ	Nurseries in higher SES	1,911 / 7,996	333 / 1,393	1,840 / 7,699	531 / 2,222	-77.5	366.9
	Nurseries in lower SES	1,424* / 5,958	306.5 / 1,282	1,785 / 7,468	635 / 2,657	361.6	481.4
CHO (% of total energy)	Nurseries in higher SES	45.9	5.3	44.2	6.4	-1.6	7.3
	Nurseries in lower SES	46.5	7.7	44.3	7.0	-2.1	7.3
NME sugar (% of total energy)	Nurseries in higher SES	15.1	5.5	12.3	4.2	-2.7	5.5
	Nurseries in lower SES	13.5	7.1	10.6	4.7	-2.9	5.7
NSP (g) per day	Nurseries in higher SES	11.5	3.1	14.5	3.9	2.6	4.2
	Nurseries in lower SES	8.9	1.9	12.9	5.5	4.0	6.1
Fat (% of total energy)	Nurseries in higher SES	34.8	4.2	36.3	4.6	1.4	6.0
	Nurseries in lower SES	34.7	6.3	38.4	6.1	3.6	8.9
Saturated fat (% of total energy)	Nurseries in higher SES	12.4	2.7	13.7	1.9	0.9	3.3
	Nurseries in lower SES	12.7	3.0	14.5	2.8	1.8	3.0
Protein (g) per day	Nurseries in higher SES	72.0	12.7	68.9	12.7	-3.3	9.5
	Nurseries in lower SES	57.1*	12.0	70.5	19.1	13.4~	18.1

***p value = < 0.05: significant difference between higher and lower SES group at set time**

~ p value = <0.05: significant difference in change between higher and lower SES groups over time

Table 6.5 shows the difference in mean intake of energy and macronutrient from baseline (August 2005) to stage 3 (April 2007) of parents from the higher SES group compared to parents from the lower SES group. Energy intake (kcal) was significantly lower in the lower SES group at baseline ($p = < 0.05$); by stage 3 there was no significant difference in intake. At both stages in both groups, intake was lower than the EAR. Protein (g/d) was significantly lower in the lower SES group at baseline ($p = 0.04$); by stage 3 there was no significant difference in intake. At both stages in both groups, protein intake was higher than the RNI (45 g/d). There was a significant difference ($p = 0.03$) in the change over time of mean protein intake (g/d) due to a minor decrease in intake in the higher SES group and an increase in the lower SES group. Intakes of NME sugar decreased in both groups over time; by stage 3, NME sugar intakes in the lower SES group were below the recommended maximum intake. Saturated fat intake was greater than the recommended maximum intake at baseline in bother groups, and increased in both groups over time. Intakes of NSP increased in both groups; neither group met the recommended minimum intake of 18 g/d by stage 3 and intakes were still significantly lower than both the 1991 guideline for NSP intake of 18 g/d (p = 0.05).

Table 6.6: Comparative data relating to micronutrient consumption between adult participants at baseline and stage 3 by socio-economic status (nurseries in higher SES n=12; nurseries in lower SES n=5):

		Baseline		Stage 3		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Vitamin A (µg) per day	Nurseries in higher SES	740	284	934	349	196.0~	489.1
	Nurseries in lower SES	740	237.5	817	359	77.0	344.3
Folate (µg) per day	Nurseries in higher SES	236.0	74.0	254.2	71.8	15.9	48.7
	Nurseries in lower SES	189.4	18.6	234.8	98.7	45.4	111.0
Vitamin C (mg) per day	Nurseries in higher SES	105.6	47.5	124.2	65.4	14.1	60.1
	Nurseries in lower SES	89.1	55.1	80.3	67.1	-8.8	82.2
Calcium (mg) per day	Nurseries in higher SES	831.2	263.4	822.9	294.2	-12.6	167.7
	Nurseries in lower SES	554.6*	149.2	727.8	141.5	~173.2	183.6
Iron (mg) per day	Nurseries in higher SES	11.5	2.0	11.8	4.4	1.3	4.9
	Nurseries in lower SES	7.8*	1.5	11.5	7.6	3.7	7.3
Zinc (mg) per day	Nurseries in higher SES	8.3	1.6	7.9	1.9	0.1	1.6
	Nurseries in lower SES	5.6*	1.4	7.9	2.1	2.3	2.8
Salt (g) per day	Nurseries in higher SES	6.3	1.2	6.5	1.8	0.25	1.84
	Nurseries in lower SES	5.1*	0.8	6.5	1.7	1.47	1.46

***p value = < 0.05: significant difference between higher and lower SES group at set time**

~ p value = <0.05: significant difference in change between higher and lower SES groups over time

Table 6.6 shows the difference in mean intake of micronutrients from baseline (August 2005) to stage 3 (April 2007) of parents from the higher SES group compared to parents from the lower SES group. At baseline there was a significantly lower mean intake (p = < 0.05) of calcium and zinc in the lower SES group, and intakes in the lower SES group were below the RNI for folate (200 µg/d), calcium (700 mg/d) and zinc (7 mg/d). There was a significant change over time calcium intake; the lower SES group increased intake by 173.2 mg/d from baseline to stage 3 (p = 0.05). By stage 3 there was no significant difference in mean intakes of any micronutrients between groups, and all intakes of all micronutrients were above the RNI with the exception of iron; at baseline, iron intakes were significantly lower (p = 0.05) in the lower SES group (7.8 mg/d compared to 11.5

mg/d). By stage 3, the lower SES group had increased intake by 3.7 mg/d to 11.5 mg/d and the higher SES group had increased intake by 1.3 mg/d to 11.8 mg/d. However, neither group at any stage of the study achieved the RNI of 14.8 mg/d. There was a significant difference in change over time ($p = < 0.05$) in Vitamin A intake, which increased by 196 µg/d in the higher SES group compared to 77µg/d in the lower SES group. At baseline, salt intake was significantly lower in the lower SES group ($p = < 0.05$); by stage both groups consumed 6.5 g/d, which is more than the recommended maximum intake (6 g/d).

Table 6.7: Comparative data relating to fruit and vegetable consumption between all child participants at baseline and stage 3 (N=17):

	Stage	Mean	St. Dev.
Fruit (g) per day[19]	Baseline	106	65
	Stage 3	137	101
Vegetable (g) per day	Baseline	75	54
	Stage 3	101	55
Fruit and vegetable (g) per day	Baseline	180	105
	Stage 3	238	120
Different fruits consumed over 5 day period	Baseline	4.7	3.1
	Stage 3	4.9	2.8
Different vegetable consumed over 5 day period	Baseline	5.8	3.0
	Stage 3	6.0	3.5

Table 6.7 shows the difference in mean intake of fruit and vegetables from baseline (August 2005) to stage 3 (June 2007) in children. There was no significant difference in mean intake (g/d) or variety of fruit and vegetables consumed over the 5 day period. Over the duration of the study, combined intake of fruit and vegetables increased by 58 g/d.

Table 6.8 shows the difference in mean intake of energy and macronutrients from baseline (August 2005) to stage 3 (June 2007) in children. There was no significant difference in mean intake of energy or macronutrients from baseline to stage 3. Energy intake was greater than the EAR at both stages. Mean NME sugar and saturated fat intake was high at both stages. Protein intake was significantly greater ($p = < 0.05$) than the RNI for protein at both stages (14.5 g/d for children aged 1-3 years; 19.7 g/d for children aged 4-6 years).

[19] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 6.8: Comparative data relating to macronutrient consumption between all child participants at baseline and stage 3 (n=17):

	Stage	Mean	St. Dev.
Kcal / kJ	Baseline	1,486 / 6,217	227 / 950
	Stage 3	1,593 / 6665	245 / 1025
CHO (% of total energy)	Baseline	50.1	5.8
	Stage 3	50.2	5.5
NME sugar (% of total energy)	Baseline	18.8	5.9
	Stage 3	18.9	6.1
NSP (g) per day	Baseline	8.4	2.3
	Stage 3	9.4	2.8
Fat (% of total energy)	Baseline	36.0	5.0
	Stage 3	35.0	4.7
Saturated fat (% of total energy)	Baseline	14.8	3.1
	Stage 3	14.3	2.3
Protein (g) per day	Baseline	50.5	9.8
	Stage 3	57.1	10.3

Table 6.9: Comparative data relating to micronutrient consumption between all child participants at baseline and stage 3 (n=17):

	Stage	Mean	St. Dev.
Vitamin A (μg) per day	Baseline	552	240
	Stage 3	745	366
Folate (μg) per day	Baseline	166.1	58.2
	Stage 3	195.6	45.3
Vitamin C (mg) per day	Baseline	109.0	94.2
	Stage 3	131.1	75.8
Calcium (mg) per day	Baseline	761.3	225.7
	Stage 3	884.7	190.8
Iron (mg) per day	Baseline	7.3	2.0
	Stage 3	7.8	1.8
Zinc (mg) per day	Baseline	5.4*	1.4
	Stage 3	6.3	1.2
Salt (g) per day	Baseline	5.2	0.9
	Stage 3	5.7	1.5

***p value = < 0.05: significant difference between higher and lower SES group at set time**

Table 6.9 shows the difference in mean intake of micronutrients from baseline (August 2005) to stage 3 (June 2007) in children. Intake of all micronutrients increased marginally but not significantly over the duration of the study. There was a significant increase ($p = < 0.05$) in mean intake of zinc from baseline to stage 3. Mean intakes of all micronutrients were greater than the RNI at baseline and stage 3. Intakes of salt were higher than the recommended maximum intake of 2 g/d for children aged 1-3 years (baseline) and 3 g/d for children aged 4-6 years (stage 3).

Table 6.10: Comparative data relating to fruit and vegetable consumption between child participants at baseline and stage 3 by socio-economic status (nurseries in higher SES n=12; nurseries in lower SES n=5):

		Baseline		Stage 3		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Change**	**St. Dev**
Fruit per day (g)[20]	Nurseries in higher SES	115	63	144	108	24.9	89.7
	Nurseries in lower SES	83	71	120	93	36.4	73.8
Vegetable per day (g)	Nurseries in higher SES	90	53	109	52	13.2	55.5
	Nurseries in lower SES	37	39	83	65	46	39.3
Fruit and vegetable (g) per day	Nurseries in higher SES	206	97	253	108	38.2	109.0
	Nurseries in lower SES	120	107	203	151	82.4	103.9
Different fruits consumed over 5 day period	Nurseries in higher SES	5.3	3.1	5.25	2.958	0.0	2.4
	Nurseries in lower SES	3.2	2.8	4.00	2.550	0.8	2.7
Different vegetable consumed over 5 day period	Nurseries in higher SES	6.3	2.5	6.2	2.6	-0.5	2.9
	Nurseries in lower SES	4.4	3.9	5.4	5.5	1.0	2.5

Table 6.10 shows the difference in mean intake of fruit and vegetables from baseline (August 2005) to stage 3 (April 2007) of children from the higher SES group compared to children from the SES group. There was no significant difference in fruit and vegetable intakes between the groups at baseline or stage 3. Intake of fruit and vegetables was greater in the higher SES group at both stages. Over the duration of the study, children from the lower SES group increased intake of combined fruit and vegetables by 83 g/d compared to 47 g/d in the higher SES group. There was a marginal increase in the variety of fruits and vegetables consumed by children from the lower SES group over time.

[20] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.

Table 6.11: Comparative data relating to macronutrient consumption between child participants at baseline and stage 3 by socio-economic status (nurseries in higher SES n=12; nurseries in lower SES n=5):

		Baseline		Stage 3		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Kcal/KJ	Nurseries in higher SES	1,496 / 6,259	229 958	1,613 / 6749	235 / 983	125.8	336.0
	Nurseries in lower SES	1,463 / 6,122	248 1,038	1,545 / 6,464	292 / 1,222	81.2	219.8
CHO (% of total energy)	Nurseries in higher SES	51.6	4.8	50.0	6.1	-2.2	4.8
	Nurseries in lower SES	46.3	6.8	50.5	4.4	4.2	6.0
NME sugar (% of total energy)	Nurseries in higher SES	19.5	5.2	19.1	5.7	-0.4	5.1
	Nurseries in lower SES	17.1	7.7	18.5	7.5	1.4	4.2
NSP (g) per day	Nurseries in higher SES	9.5	1.5	10.1	2.0	0.4	2.4
	Nurseries in lower SES	5.8*	1.9	7.6	3.7	1.7	2.5
Fat (% of total energy)	Nurseries in higher SES	34.4	4.9	34.8	5.0	0.8	5.0
	Nurseries in lower SES	39.7*	3.1	35.4	4.2	-4.3	5.7
Saturated fat (% of total energy)	Nurseries in higher SES	14.2	3.4	14.4	2.8	0.2	3.4
	Nurseries in lower SES	16.3	1.9	14.1	2.3	-2.2	3.9
Protein (g) per day	Nurseries in higher SES	50.8	9.1	59.0	11.3	9.1	12.5
	Nurseries in lower SES	49.6	12.5	52.4	5.5	2.8	8.2

***p value = >0.05: significant difference between higher and lower SES group at set time**

Table 6.10 shows the difference in mean intake of energy and macronutrients from baseline (August 2005) to stage 3 (April 2007) of children from the higher SES group compared to children from the SES group. Children from the higher SES group consumed significantly more (p = 0.001) NSP (9.5 g/d compared to 5.8 g/d) and significantly less (p = 0.04) fat (39.7 % energy intake compared to 34.4 %) than children from the lower SES group at baseline. There was no significant difference in mean intake of NSP (g/d) or fat (% energy intake) by stage 3. Intake of NME sugar and saturated fat was higher than the recommended % energy intake in both groups[21]. Intake of protein

[21] 1991 DoH EAR for CHO, NME sugar, fat and saturated fat as % energy intake is from age 5 onwards which applies to children at stage 3.

was significantly greater than the RNI in children from both groups at baseline (p = 0.03) and stage 3 (p = 0.04).

Table 6.12: Comparative data relating to micronutrient consumption between child participants at baseline and stage 3 by socio-economic status (nurseries in higher SES n=12; nurseries in lower SES, n=5):

		Baseline		Stage 3		Change over time	
Nutrient	**Group**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Vitamin A (µg) per day	Nurseries in higher SES	573	231	762	377	155.9	432.8
	Nurseries in lower SES	502	281	703	376	201.4	447.4
Folate (µg) per day	Nurseries in higher SES	167.5	43.8	194.8	42.8	27.5	45.7
	Nurseries in lower SES	162.8	90.9	197.4	56.3	34.6	54.6
Vitamin C (mg) per day	Nurseries in higher SES	109.4	70.8	137.2	81.7	22.9	42.8
	Nurseries in lower SES	108.0	147.3	116.6	65.4	8.5~	143.2
Calcium (mg) per day	Nurseries in higher SES	795.8	235.5	913.0	189.1	121.7	215.5
	Nurseries in lower SES	678.6	197.9	816.8	197.8	138.2	183.4
Iron (mg) per day	Nurseries in higher SES	7.8	2.0	8.1	1.9	0.4	2.2
	Nurseries in lower SES	6.2	1.2	7.0	1.4	0.8	1.6
Zinc (mg) per day	Nurseries in higher SES	5.6	1.3	6.4	1.1	0.9	1.0
	Nurseries in lower SES	4.8	1.7	6.1	1.3	1.3	1.3
Salt (g) per day	Nurseries in higher SES	5.1	1.1	5.8	1.7	0.76	1.6
	Nurseries in lower SES	5.3	0.6	5.4	0.9	0.12	0.8

***p value =< 0.05: significant difference between higher and lower SES group at set time**
~ p value = <0.05: significant difference in change between higher and lower SES groups over time

Table 6.10 shows the difference in mean intake of micronutrients from baseline (August 2005) to stage 3 (April 2007) of children from the higher SES group compared to children from the SES group. Intake of all micronutrients increased in both groups over time. There was a significant difference (p = < 0.05) in the change over time of Vitamin C, with children from the higher SES group increasing their consumption by 22.9 mg/d from baseline to stage 3, compared to an increase of 8.5 mg/d in the lower SES group. Intakes of iron and zinc were below the RNI at baseline in the lower SES group but increased their intake by stage 3. Intakes of salt were greater than the recommended maximum intake of 2 g/d for children aged 1-3 years (baseline) and 3 g/d for children aged 4-6 years (stage 3) in both groups.

7 Results; questionnaire

7.1 Baseline questionnaire analysis

At baseline, a questionnaire was given to all participating families to better understand factors that affect fruit and vegetable intake by a) identifying extrinsic barriers such as cost, availability, quality; b) identifying intrinsic barriers such as knowledge, attitude and preferences; c) identifying parents' shopping and cooking habits. In total, 48 completed questionnaires were returned at baseline. One questionnaire was not legible and was therefore discarded, meaning that 47 questionnaires were analysed. Of these, 21 parents were from the higher SES group and 26 parents were from the lower SES group. All of the data has been presented with actual number and the percentage. 'Percentage of combined' refers to the percentage out of all 47 respondents. 'Percentage of higher SES' refers to the percentage out of the 21 respondents from the higher SES group; percentage of lower SES refers to the percentage out of the 26 respondents from the lower SES group.

7.1.1 Fruit and vegetables purchased

Parents were asked where they mostly shopped for their fruit and vegetables. The majority of all parents (72 %) purchasing produce from the supermarket; 15 % from food stores such as Lidl, Iceland, Kwik Save and ScotMid; 2 % shopping from the local community food co-ops and 11 % shopping in 'other' stores. Findings were similar for vegetables, with the majority of parents (67.4 %) purchasing produce from the supermarket, 19.6 % from food stores such as Lidl, Iceland, Kwik Save and ScotMid, 2 % shopping from local community food co-ops and 11 % shopping in 'other' stores. No parents reported purchasing fruit or vegetables in local shops. There was no significant difference between SES groups in where items were purchased.

7.1.2 Extrinsic and intrinsic barriers to eating fruit and vegetables

A list of statements looking at potential barriers to healthy eating such as cost, preparation time, taste, access and affordability was given to the parents, who were asked to score each statement from the following choices: 'agree'; 'neither agree or disagree'; 'disagree'. Data was then analysed to identify differences in responses between the SES groups.

Table 7.1: Responses to negative statements at baseline:

Statement	SES group	Disagree	Neither	Agree
"Fruit cost too much"	Combined Higher Lower	22 (47%) 8 (38%) 14 (54%)	20 (42.5%) 11 (52%) 9 (34.5%)	5 (10.5%) 2 (10%) 3 (11.5%)
"Vegetables cost too much"	Combined Higher Lower	27 (57.5%) 12 (57%) 15 (57.5%)	17 (36%) 8 (38%) 9 (34.5%)	3 (6.55) 1 (5%) 2 (8)
"Fruit takes too much time to prepare (peeling etc.)	Combined Higher Lower	43 (91.5%) 18 (85.5%) 25 (96%)	3 (6.5%) 2 (9.5%) 1 (4%)	1 (2%) 1 (5%) 0 (0%)
"Vegetables take too much time to prepare"	Combined Higher Lower	40 (85%) 17 (81%) 23 (88.5%)	6 (13%) 3 (14%) 3 (11.5%)	1 (2%) 1 (5%) 0 (0%)
"Fruit goes off too quickly and money is wasted"	Combined Higher Lower	22 (47%) 12 (57%) 10 (38.5%)	15 (32%) 1 (5%) 12 (46%)	10 (21%) 6 (28%) 4 (15.5%)
"Vegetables go off too quickly and money is wasted"	Combined Higher Lower	30 (64%) 16 (76%) 14 (54%)*	10 (21%) 1 (5%) 9 (34.5%)	7 (15%) 4 (19%) 3 (11.5%)
"Children prefer other snacks such as crisps/sweets"	Combined Higher Lower	16 (34%) 7 (33.5%) 9 (34.5%)	16 (34%) 6 (28.5%) 10 (38.5%)	15 (32%) 8 (38%) 7 (27%)
"It can be difficult to cook fruit and make it tasty"	Combined Higher Lower	21 (45%) 10 (47.5%) 11 (42%)	16 (34%) 9 (42.5%) 7 (27%)	10 (21%) 2 (10%) 8 (31%)
"It can be difficult to cook vegetables and make them tasty"	Combined Higher Lower	36 (76.5) 18 (85%) 18 (69%)	5 (10.5%) 2 (10%) 3 (11.5%)	6 (13%) 1 (5%) 5 (19.5%)

***p = < 0.05**

There was a significant difference between the response by lower and higher SES groups for the statement "vegetables go off too quickly" (p = 0.045), with 76% of parents from higher SES agreeing with the statement compared to 54% from the lower SES group. There were no other significant differences between higher and lower SES groups; parents from both SES groups did not agree with any the statements relating to barriers to eating fruit and vegetables.

A list of positive statements relating to the variety and quality of fruit and vegetables in local shops were also provided. There was a significant difference between the response by lower and higher SES groups for the statement "there is good choice of fruit in local shops" (p = 0.04); more parents from nurseries in the higher SES group (62%) than lower SES (38.5%) agreed with the statement. There was also a significant difference between the response by lower and higher SES groups for the statement "there is good choice of vegetables in local shops" (p = 0.04); more parents from nurseries in the higher SES group (66%) than lower SES (34.5%) agreed with the statement. There were no other significant differences between higher and lower SES groups.

Table 7.2: Responses to positive statements at baseline:

Statement	SES group	Disagree	Neither	Agree
"There is a good choice of fruit in local shops"	Combined Higher Lower	15 (32%) 4 (19%) 11 (42%)	9 (19%) 4 (19%) 5 (19.5%)	23 (49%) 13 (62%) 10 (38.5%)*
"There is a good choice of vegetables in local shops"	Combined Higher Lower	16 (34%) 5 (24%) 11 (42%)	7 (14%) 2 (10%) 5 (19.5%)	24 (51%) 14 (66%) 10 (38.5%)*
"The quality of fruit in local shops is good"	Combined Higher Lower	14 (30%) 6 (28.%) 8 (31%)	19 (40%) 10 (47.%) 9 (34.5%)	14 (30%) 5 (24%) 9 (34.5%)
"The quality of vegetables in local shops good"	Combined Higher Lower	13 (27.5%) 5 (24%) 8 (31%)	20 (42.5%) 9 (43%) 11 (42%)	14 (30%) 7 (33%) 7 (27%)

***p = < 0.05**

7.1.3 Fruit and vegetable preferences

At baseline, parents were asked to state their taste preference, and the taste preference of their child, of a list of 14 fruits and 6 vegetables. The purpose of this was to identify any correlation between adult and child preferences. Parents were asked to mark on a Likert scale from 1 to 5 how much they, and their child liked or disliked each fruit and vegetable (1: Really dislike the item; 2: Dislike; 3: Neither like nor dislike; 4: Like; 5: Really like). If the item had not been tasted, parents were asked to leave the row blank (score = 0). At baseline, 47 parents returned the tables relating to parent and child preferences, however 3 questionnaires had incomplete data relating to fruit and vegetable preferences meaning that the total number of responses analysed was 44.

Correlations between datasets of adults and children for each fruit and vegetable were determined using a Spearman Rank test. There was a very strong correlation (p = < 0.01) between preferences of adults and preferences of children in 12 of the fruit and vegetables analysed, a strong correlation (p = < 0.05) in a further 5 of the fruit and vegetables. There were only 3 fruit and vegetables with no significant correlation between parent and child food preferences. Of the 880 comparable data sets (fruit = 616; vegetables = 264), there were only 9 instances (1 %) where a parent reported that they 'did not like' something that the child 'liked'. There was no significant difference in preferences of any of the fruits and vegetables based on SES group.

Table 7.3: Preference in fruit and vegetable intake at baseline in adults (n=44) and children (n=44)

Fruit or vegetable type	Adult data (n = 44)				Child data (n = 44)				Correlation (Spearman Rank)	Significance
	Haven't tasted	Dislike to really dislike	Neither like or dislike	Like or really like	Haven't tasted	Dislike to really dislike	Neither like or dislike	Like or really like		
Pear	0	1	12	31	0	9	6	29	.501	0.001**
Apple	0	1	6	37	0	1	6	37	.410	0.005**
Banana	0	4	5	35	0	6	9	29	.383	0.009**
Melon	0	2	7	35	2	14	5	23	.547	0.001**
Kiwi	0	6	14	24	3	20	6	15	.432	0.003**
Pineapple	0	2	4	38	3	13	15	13	.277	0.062
Strawberry	0	4	1	39	0	8	4	32	.518	0.001**
Orange	0	5	6	33	0	9	8	27	.437	0.002**
Satsuma	0	2	3	39	3	6	5	30	.428	0.003**
Grape	0	1	1	42	0	1	1	42	.352	0.016*
Mango	0	10	15	14	12	16	5	11	.352	0.017*
Plum	0	9	10	25	4	13	8	19	.562	0.001**
Nectarine	0	3	5	36	5	10	8	21	.339	0.021*
Peach	0	3	9	32	3	8	12	21	.388	0.008**
Cucumber	0	3	9	32	1	16	4	23	.283	0.057
Tomato	0	8	3	33	0	21	7	16	.464	0.001**
Carrot	0	3	7	34	1	8	7	28	.427	0.003**
Bell pepper	0	5	8	31	4	25	7	8	.184	0.220
Broccoli	0	3	6	35	1	12	5	26	.368	0.012*
Cauliflower	0	6	6	32	1	19	3	21	.371	0.011*

***p = < 0.05 **p = <0.01**

7.1.4 Knowledge of the 5 a day message

All 47 participants (100%) were aware of the '5 a day' message (NHS, 2015). Of the 47 parents who participated, 32 parents (68%) felt that the five portions per day was just right, 10 parents (21%) felt that this was a 'bit too much' and 5 parents (11%) felt that this was 'not enough'. There was no significant difference in view between parents from the higher and lower socio-economic group.

Parents were then provided with a list of fruit and vegetables and asked to identify which fruit and vegetables equated to 'one adult-sized portion'. A higher percentage of parents from the lower SES group answered each question correctly. The question "is 1 melon a portion of fruit?" was answered correctly by 22 of the 26 parents (85%) from the lower SES group compared to 13 of the 21 parents (62%) from the higher SES group (p = 0.036). The question "is ½ a banana a portion of fruit?" was answered correctly by 17 of the 26 (65.5%) parents from the lower SES group compared to 9 of the 21 parents (43%) from the higher SES group (p = 0.033). The question “is 1 punnet of strawberries a portion of fruit?” was answered correctly by 22 of the 26 parents (81%) from the lower SES group compared to 11 of the 21 parents (57%) from the higher SES group (p = 0.016). There was a marginal difference between the response by lower and higher SES groups for the question “is ½ a pineapple a portion of fruit?” (p = 0.074). The question was answered correctly by 19 of the 26 parents (73%) from the lower SES group and by 10 of the 21 parents (48%) from the higher SES group.

Table 7.4: Knowledge of portion sizes

Do the following fruits equal one adult-sized portion?	**SES group**	**Yes**	**No**
1 melon (correct answer is ‘**No**’)	Combined Higher Lower	13 (28%) 8 (38%) 4 (15%)	34 (72%) 13 (62%) 22 (85%)*
1 glass fresh orange juice (correct answer is ‘**Yes**’)	Combined Higher Lower	41 (85%) 18 (86%) 23 (88%)	6 (15%) 3 (14%) 3 (12%)
1 cherry tomato (correct answer is ‘**No**’)	Combined Higher Lower	3 (6%) 1 (5%) 2 (8%)	44 (94%) 20 (95%) 24 (92%)
½ a bell pepper (correct answer is ‘**Yes**’)	Combined Higher Lower	19 (40%) 7 (33.5%) 12 (46%)	28 (60%) 14 (66.5%) 14 (54%)
½ a banana (correct answer is ‘**No**’)	Combined Higher Lower	21 (45%) 12 (57%) 9 (34.5%)	26 (55%) 9 (43%) 17 (65.5%)*
1 apple (correct answer is ‘**Yes**’)	Combined Higher Lower	46 (98%) 21 (100%) 25 (96%)	1 (2%) 0 (0%) 1 (4%)
1 punnet strawberries (correct answer is ‘**No**’)	Combined Higher Lower	14 (30%) 9 (43%) 5 (19%)	33 (70%) 12 (57%) 21 (81%)*
3 broccoli spears (correct answer is ‘**Yes**’)	Combined Higher Lower	34 (72%) 17 (81%) 17 (65.5%)	13 (28%) 4 (19%) 9 (34.5%)
½ a pineapple (correct answer is ‘**No**’)	Combined Higher Lower	18 (38%) 11 (52%) 7 (27%)	29 (62%) 10 (48%) 19 (73%)
4 dried apricots (correct answer is ‘**Yes**’)	Combined Higher Lower	34 (72%) 14 (66.5%) 20 (77%)	13 (28%) 7 (33.5%) 6 (33%)

***p = < 0.05**

7.1.5 Confidence, aptitude and culinary skills

Parents were then asked how often they carried out culinary tasks, such as baking, making soup, cooking a meal from scratch, experimenting with new fruits and vegetables.

Table 7.5: Culinary skills

Question	SES group	Regularly or occasionally	Rarely or never	Missing data
How often do you bake?	Combined Higher Lower	16 (34%) 6 (28%) 10 (38.5%)	30 (64%) 14 (67%) 16 (61.5%)	1 (2%) 1 (5%) 0 (0%)
How often do you make soup?	Combined Higher Lower	22 (47%) 13 (62%) 9 (34.5%)*	23 (49%) 8 (38%) 15 (57.5%)	2 (4%) 0 (0%) 2 (8%)
How often do you use a recipe book?	Combined Higher Lower	15 (32%) 8 (38%) 7 (27%)	31 (66%) 13 (62%) 18 (69%)	1 (2%) 0 (0%) 1 (4%)
How often do you cook with your own recipe?	Combined Higher Lower	40 (85%) 17 (71.5%) 23 (88%)	6 (13%) 3 (23.5%) 3 (12%)	1 (2%) 1 (5%) 0 (0%)
How often do you try new fruits?	Combined Higher Lower	16 (34%) 6 (28.5%) 10 (38.5%)	30 (64%) 15 (71.5%) 15 (57.5%)	1 (2%) 0 (0%) 1 (4%)
How often do you try new vegetables?	Combined Higher Lower	15 (32%) 5 (23.5%) 10 (38.5%)	30 (64%) 15 (71.5%) 15 (57.5%)	2 (4%) 1 (5%) 1 (4%)

***p = < 0.05**

There was no significant difference in the responses between the higher and lower SES groups at baseline with the exception of "How often do you make soup"; 62 % of parents from the higher SES group reported making soup compared to 34.5 % of the lower SES group (p = 0.04). The majority of parents said that they rarely or never try new fruits or vegetables (64 %).

7.2 Stage 3 questionnaire analysis

There was a reduced response by stage 3; the total number of adequately completed questionnaires at stage 3 was 17; 12 from the higher SES group and 5 from the lower SES group. This low response rate at stage 3 has most likely impacted the statistical significance of comparative results.

There was no significant change to shopping patterns or to culinary habits over the duration of the study. Perceptions of barriers remained the same, with the exception of a marginal positive change (p = < 0.08) to the statement "children prefer other snacks" in the lower SES group. There was no significant difference over time in the correlation between adult and child fruit and vegetable preferences. There was no difference at stage 3 between preferences of adults and children from different socio-economic groups.

Table 7.6: Knowledge of portion sizes from baseline to stage 3 (n=17)

	SES group	Baseline		Stage 3	
Do the following fruits equal one portion?		**Yes**	**No**	**Yes**	**No**
1 melon (correct answer is '**No**')	Combined Higher Lower	6 5 1	11 6 5	2 2 0	15 9 6
1 glass fresh orange juice (correct answer is '**Yes**')	Combined Higher Lower	16 11 5	1 0 1	16 10 6	1 1 0
1 cherry tomato (correct answer is '**No**')	Combined Higher Lower	1 1 0	16 10 6	0 0 0	17 11 6
½ a bell pepper (correct answer is '**Yes**')	Combined Higher Lower	5 3 2	12 8 4	10 7 3	7 4 3
½ a banana (correct answer is '**No**')	Combined Higher Lower	8 6 2	9 5 4	5 2 3	12 9 3
1 apple (correct answer is '**Yes**')	Combined Higher Lower	17 11 6	0 0 0	17 11 6	0 0 0
1 punnet strawberries (correct answer is '**No**')	Combined Higher Lower	5 4 1	12 7 5	3 2 1	14 9 5
3 broccoli spears (correct answer is '**Yes**')	Combined Higher Lower	12 9 2	5 2 3	15 10 5	2 1 1
½ a pineapple (correct answer is '**No**')	Combined Higher Lower	9 6 3	8 5 3	8 6 2	9 5 4
4 dried apricots (correct answer is '**Yes**')	Combined Higher Lower	12 8 4	5 3 2	14 9 5	3 2 1

$*p = < 0.05$

There was no significant increase in knowledge of portion sizes over the duration of the research period, although parents from both groups did improve their knowledge of some portion sizes (melon, bell pepper, banana, strawberries, apricot) from baseline to stage 3. The parents from the lower SES group (n=5) had better knowledge of portion sizes than the parents from the higher SES group (n=12) at both stages (table 7.6). There was no significant increase over time in the number of parents who baked, made soup, used a recipe from a book or tried new fruits and vegetables (table 7.7). Results from the stage 3 questionnaires completed by parents from the lower SES group (n=5) are discussed in more detail in section 8 (Results: Case Studies).

Table 7.7: Changes in culinary behaviour from baseline to stage 3 (n=17)

Question	**SES group**	**Baseline**		**Stage 3**	
		Regularly or occasionally	**Rarely or never**	**Regularly or occasionally**	**Rarely or never**
How often do you bake?	Combined Higher Lower	6 3 3	11 8 3	10 7 3	7 4 3
How often do you make soup?	Combined Higher Lower	9 6 3	8 5 3	13 9 4	4 2 2
How often do you use a recipe book?	Combined Higher Lower	7 5 2	10 6 4	7 5 2	10 6 4
How often do you cook with your own recipe?	Combined Higher Lower	15 9 6	2 2 0	14 9 5	3 2 1
How often do you try new fruits?	Combined Higher Lower	4 2 2	13 9 4	4 2 2	13 9 4
How often do you try new vegetables?	Combined Higher Lower	6 4 2	11 7 4	6 4 2	11 7 4

$^*p = < 0.05$

8 Results; Case Studies

The following section looks in more detail at the data of the families from the lower SES group who completed diet diaries and questionnaires at all stages (n = 5). There is a table which contains the parent and child dietary data for each family, and compares both to the Dietary Reference Values Department of Health 1991; SACN, 2015). Findings from the questionnaire are also included. Key findings are noted after each table.

8.1 Family 1

Figure 8.1 contains data relating to the dietary intake of the mother and child from 'Family 1'. Over the duration of the study, the parent's intake of fruit and vegetables increased by 238 g/d (3 portions) from 184 g/d at baseline to 422 g/d at stage 3, by which stage intakes were greater than the 400 g/d guideline. A similar increase in combined fruit and vegetable intake was seen in dietary intake of the child, increasing from 77 g/d at baseline to 337 g/d at stage 3. At baseline the adult energy intake was very low (993 kcal/d); this increased over the duration of the study (1,404 kcal/d by stage 3) but did not meet the 1991 Department of Health EAR at any stage. Over the duration of the study, % of energy from CHO decreased and % energy from fat increased; at stage 2 saturated fat intake was 17 % of the daily energy intake, this decreased to 15.6 % by stage 3 but is still 4.6 % greater than the recommended upper limit of 11 % total energy intake. NSP intake increased over time, which correlates with the increase in fruit and vegetable intake. NME sugar intake was low. Protein intake (g/d) was greater than the RNI at all stages. At baseline, folate, calcium and zinc intakes were lower than the RNI for adult females aged 19 to 50 years, and iron levels were below the LRNI for adult females (8 mg/d). By stage 3, intakes of folate, calcium and zinc were above the RNI. Iron intakes were below the RNI at all stages, but by stage 2, intake was above the LRNI. Reported salt intake was above the recommended upper intake of 6 g/d at stages 2 and 3.

Child CHO and fat intake (% total energy) were in line with recommendations; NME sugar intake increased over time and was higher than the recommended upper intake of 11 % total energy intake at all stages. Saturated fat intake was also high, although intakes decreased over time. NSP intakes increased marginally over time. Protein intakes were above the RNI at all stages. At baseline, intakes of iron and zinc were lower than the RNI; intakes increased by stage 2. Intakes of all other micronutrients were greater than the RNI at baseline and intakes of all micronutrients increased over time.

Table 8.1: Dietary data from lower SES Family 1

Food or nutrient	Guideline intake Adult[22]	Adult Baseline	Stage 2	Stage 3	Guideline intake child	Child Baseline	Stage 2	Stage 3
Fruit intake (g)[23]	-	31	26	226	-	53	77	218
Veg intake (g)	-	153	105	196	-	24	64	119
Total fruit and veg[24] (g)	≥ 400	184	131	422	-	77	141	337
Daily portions	≥ 5				-	-	-	-
Variety fruits over 5 day period	-	1	2	7	-	1	4	6
Variety veg over 5 day period	-	8	8	8	-	4	4	9
Energy intake (kcal/kJ)	~ 1940 / ~ 8,109 [25]	993	1404	1684	1,198 / 5,008	1431	1522	1329
CHO intake (% of total energy)	~ 50	46.8	32.4	38.4	50%[26]	42.6	45.7	49.8
NMES intake (% of total energy)	≤ 11	12.2	5.7	4.5	-	13.0	14.7	14.9
NSP intake (g)	≥ 18	8.70	10.50	14.90	-	7.30	8.90	8.10
Fat intake (% of total energy)	~ 35	28.2	45.3	40.7	-	41.8	38.7	33.7
Sat fat intake (% of total energy)	≤ 11	8.8	17.0	15.6	-	16.0	15.0	14.5
Protein intake (g)	45	61.5	73.8	86.8	14.5/19.7[27]	53.8	59.4	54.3
Vitamin A intake (μg)	RNI 600 LRNI 250	625.0	1283.0	1192.0	RNI 400 LRNI 200	330.0	644.0	723.0
Folate intake (μg)	RNI 200 LRNI 100	190	179	244	RNI 70 LRNI 50	126	160	204
Vit C intake (mg)	RNI 40 LRNI 10	45.3	28.9	148.3	RNI 30 LRNI 8	35.0	52.5	69.5
Ca intake (mg)	RNI 700 LRNI 400	333.0	561.0	718.0	RNI 350 LRNI 275	601.0	673.0	924.0
Fe intake (mg)	RNI 14.8 LRNI 8	6.8	10.2	12.5	RNI 6.9 LRNI 3.3	5.5	7.1	7.4
Zn intake (mg)	RNI 7 LRNI 4	4.7	10.5	10.7	RNI 5 LRNI 4	4.3	7.3	7.3
Salt intake (g)	< 6	4.64	7.28	6.95	≤ 2 / ≤ 3	5.68	6.02	4.65

Over the duration of the study there were changes to the response to the statements regarding barriers, with responses to statements 6.1, 6.2 and 6.4 being changed from strongly disagree at baseline to 'neither agree or disagree' at stage 3. There was a positive change to statement 6.5 which changed from 'strongly agree' to 'strongly disagree' which may indicate that the parent has become better at using the purchased fruit and vegetables. There were positive changes in preference to some fruit and vegetables by

[22] Guideline nutrient intake for energy is EAR; for NMES, NSP, fat and saturated fat is population average DRV; for protein and all micronutrients except salt is RNI; for salt is NHS recommended upper limit.
[23] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.
[24] WHO recommendation adopted by NHS UK
[25] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old.
[26] Updated SACN recommendation (2015)
[27] This is the RNI for protein for children aged 1 to 3 years; increasing to 19.7 g/d for children aged 4 – 6 years (stage 2 and 3)

the child: banana, orange and satsuma from ‘really dislike’ to ‘really like’; pineapple, mango, broccoli and cauliflower from ‘neither like or dislike’ to ‘really like’. There was a negative change in preference of carrot and melon (from ‘really like’ to ‘really dislike’). Response to whether the 5 a day message changed from ‘just right’ to a ‘bit too much’. There was an increase in the number of portion sizes correctly guessed (from 1/5 to 3/5).

8.2 Family 2

Figure 8.2 contains data relating to the dietary intake of the mother and child from ‘Family 2’. Intake of fruit by the parent increased from baseline to stage 2, but decreased from stage 2 to stage 3; overall there was a decrease of 43 g/d fruit and a decrease of 29 g/d vegetables over the duration of the study. Energy intake (kcal) increased by 959 kcal and by stage 3, intake was 2,803 kcal/d, which is 863 kcal/d above the 1991 EAR for women aged 19 to 50 years (1,940 kcal). Parent and child CHO intake (% total energy) decreased from baseline to stage 2, but increased from stage 2 to stage 3. Intakes at all stages were lower than the recommended EAR (50 % of total energy from CHO). Intakes of NME sugar by the parent were high at baseline (17.9 % total energy intake), but decreased to 10.2 % by stage 3. NSP intake by the parent at baseline increased to greater than the recommended minimum 18 g/d by stage 3. Fat intake (% of total energy intake) was in line with the EAR (35 %) at baseline but increased to 46.9 % by stage 3, 18.5 % of which came from saturated fat, which is higher than the recommended ‘no more than 11 % total energy intake from saturated fat. At baseline, intake of folate (175 μg), calcium (505 mg), iron (9.1 mg) and zinc (5.7 mg) were lower than the RNI. At stage 2, intakes of iron (9.8 mg) were still below the RNI. By stage 3, iron intakes were 14.5 mg. Salt intakes were higher than the recommended maximum intake of 6 g/d at stage 2 and 3.

Child intakes of fruit also decreased over time (-12 g/d), but intakes of vegetables increased by 66 g/d over the duration of the study. Combined fruit and vegetable intake therefore increased by 54 g/d. The variety of fruit consumed decreased from 6 items to 4 items over the 5-day research period. CHO intake (% total energy) decreased from baseline to stage 2, and increased from stage 2 to stage 3. NME sugar intakes were high at all 3 stages (19.4 % at baseline, 15.8 % at stage 2, 22.9 % at stage 3). Fat and saturated fat intake increased from baseline to stage 2, but decreased by stage 3, although intakes were still higher than the recommended EAR (42.2 % and 17.2 % respectively). At baseline, Vitamin A intake (319 μg) was below the RNI. Zinc intake was below the RNI at baseline (3.2 mg) and stage 2 (3.7 mg); iron intake increased over the duration of the study but was below the RNI at all stages (4.8 mg; 4.9 mg; 6.7 mg). Salt intake was higher than the recommended maximum intake at all stages. There was no change in fruit and vegetable preference over the duration of the study in parents or children.

Table 8.2: Dietary data from lower SES Family 2

Food or nutrient	Guideline intake Adult[28]	Adult Baseline	Stage 2	Stage 3	Guideline intake child	Child Baseline	Stage 2	Stage 3
Fruit intake (g)[29]	-	129	162	86	-	72	52	60
Veg intake (g)	-	207	179	178	-	44	75	110
Total fruit and veg[30] (g)	≥ 400	336	341	264	-	116	127	170
Daily portions	≥ 5				-	-	-	-
Variety fruits over 5 day period	-	5	7	6	-	6	2	4
Variety veg over 5 day period	-	9	11	9	-	4	2	4
Energy intake (kcal/kJ)	~ 1940 / ~ 8,109 [31]	1844	2229	2803	1,198 / 5,008	1327	1326	1691
CHO intake (% of total energy)	~ 50	42.3	33.4	36.3	50%[32]	51.3	41.4	46.4
NMES intake (% of total energy)	≤ 11	17.9	8.4	10.2	-	19.4	15.8	22.9
NSP intake (g)	≥ 18	8.60	13.90	21.80	-	5.60	8.0	7.9
Fat intake (% of total energy)	~ 35	34.3	46.4	46.9	-	37.7	43.9	42.2
Sat fat intake (% of total energy)	≤ 11	16.2	16.6	18.5	-	15.9	20.6	17.2
Protein intake (g)	45	68.8	85.9	92.9	14.5/19.7[33]	35.5	47.1	48.2
Vitamin A intake (µg)	RNI 600 LRNI 250	853.0	813.0	1145.0	RNI 400 LRNI 200	319.0	1258.0	1224.0
Folate intake (µg)	RNI 200 LRNI 100	175	238	399	RNI 70 LRNI 50	81	99	112
Vit C intake (mg)	RNI 40 LRNI 10	160.3	167.2	155.2	RNI 30 LRNI 8	38.2	25.8	95.3
Ca intake (mg)	RNI 700 LRNI 400	505.0	713.0	794.0	RNI 350 LRNI 275	437.0	540.0	496
Fe intake (mg) RNI Fe intake (mg) LRNI	RNI 14.8 LRNI 8	9.1	9.8	14.4	RNI 6.9 LRNI 3.3	4.8	4.9	6.7
Zn intake (mg)	RNI 7 LRNI 4	5.7	7.6	9.3	RNI 5 LRNI 4	3.2	3.7	5.4
Salt intake (g)	< 6	5.70	7.56	8.80	≤ 2 / ≤ 3	5.2	4.57	5.94

There were some changes over time in the response to statements relating to barriers. The response to statement 6.1 “fruit costs too much” changed from ‘disagree’ to ‘agree’,

[28] Guideline nutrient intake for energy is EAR; for NMES, NSP, fat and saturated fat is population average DRV; for protein and all micronutrients except salt is RNI; for salt is NHS recommended upper limit.
[29] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.
[30] WHO recommendation adopted by NHS UK
[31] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old.
[32] Updated SACN recommendation (2015)
[33] This is the RNI for protein for children aged 1 to 3 years; increasing to 19.7 g/d for children aged 4 – 6 years (stage 2 and 3)

which matches a decline in fruit intake, even though there was access to low cost and free fruit at the nursery. Statements 6.2 “vegetables cost too much” and 6.4 “vegetables take too much time to prepare” changed from ‘disagree’ to ‘neither agree or disagree’. The only change in child fruit preferences was a change from ‘dislike’ to ‘like’ for plum, and a change from ‘strongly dislike’ to ‘neither like or dislike’ for tomatoes. Knowledge of portion sizes remained the same (5/5 correctly guessed). There was no change to the frequency of cooking or tasting new fruit and vegetables.

8.3 Family 3

Figure 8.3 contains data relating to the dietary intake of the mother and child from ‘Family 3’. Parent intake of fruit and vegetables decreased over the duration of the study by 48 g/d. Energy intake was lower than the EAR at all stages; CHO (% of total energy intake) was low at baseline (36.3 %) but increased to 45 % by stage. Intake of NME sugar was lower than the recommended no more than 11 % of total energy intake at all stages. NSP intake was lower than the recommended 18 g/d at all stages. Fat intake (% of total energy intake) was high at baseline (45.2 %) but decreased over time to 37.8 % by stage 3. Saturated fat was lower than the recommended no more than 11 % of total energy intake at all stages. Protein intake was above the RNI at all stages. Vitamin A intake was lower than the RNI at stage 2; calcium was lower than the RNI (700 mg) and iron intake was lower than the LRNI for adult females (8 mg/d) at all stages. Zinc intake was lower than the RNI (7 mg) at baseline and stage 3.

Intake of fruit and vegetables by the child increased by 80 g/d over the duration of the study, and variety of fruit and vegetables also increased. Energy intake was above the EAR at all stages. NME sugar and saturated fat intake decreased over the duration of the study, however intakes were still greater than the recommended no more than 11 % of total energy intake at stage 3 (16.6 % and 11.9 % respectively). Intake of all micronutrients was above the RNI at all stages. Salt intake was higher than the recommended maximum intake at all stages. Positive changes were seen in fruit and vegetable preferences; at baseline the child had not tried kiwi, pineapple or mango but reported liking these by stage 3. There were also changes from dislike to like for pear, plum and nectarine over the duration of the study.

There was a change in response to statement 6.6 “vegetables go off too quickly” from ‘disagree’ to ‘agree’. The parents’ preference of banana changed from ‘really like’ to ‘really dislike’ but there was a positive change in preference to mango, plum, nectarine and peach, from ‘dislike’ or ‘neither like or dislike’ to ‘like’. There was a positive change in the child’s preference to pear and nectarine, from ‘dislike’ to ‘really like’ and in plum from ‘dislike’ to ‘like’. Kiwi went from ‘haven’t tasted’ to ‘like’, and mango and pineapple went from ‘haven’t tasted’ to ‘neither like or like’.

Table 8.3: Dietary data from lower SES Family 3

Food or nutrient	Guideline intake Adult[34]	Adult Baseline	Stage 2	Stage 3	Guideline intake child	Child Baseline	Stage 2	Stage 3
Fruit intake (g)[35]	-	40	70	14	-	193	173	218
Veg intake (g)	-	205	192	183	-	101	173	156
Total fruit and veg[36] (g)	≥ 400	245	262	197	-	294	346	374
Daily portions	≥ 5				-	-	-	-
Variety fruits over 5 day period	-	2	1	2	-	6	4	7
Variety veg over 5 day period	-	12	9	12	-	11	12	13
Energy intake (kcal/kJ)	~ 1940/ ~ 8,109 [37]	1350	1246	1117	1,198 / 5,008	1885	1810	1851
CHO intake (% of total energy)	~ 50	36.3	46.6	45.0	50%[38]	48.6	50.0	51.2
NMES intake (% of total energy)	≤ 11	6.5	11.2	10.2	-	22.6	16.8	16.6
NSP intake (g)	≥ 18	7.80	12.20	10.30	-	7.7	10.80	13.3
Fat intake (% of total energy)	~ 35	45.2	31.0	37.8	-	37.9	33.5	35.7
Sat fat intake (% of total energy)	≤ 11	12.4	11.2	11.8	-	14.0	12.6	11.9
Protein intake (g)	45	60.0	67.4	46.8	14.5/19.7[39]	63.1	74.8	61
Vitamin A intake (µg)	RNI 600 LRNI 250	1099.0	584.0	824.0	RNI 400 LRNI 200	988.0	512.0	883
Folate intake (µg)	RNI 200 LRNI 100	205	175	149	RNI 70 LRNI 50	316	249	258
Vit C intake (mg)	RNI 40 LRNI 10	51.2	56.5	47.2	RNI 30 LRNI 8	369.9	144.5	137
Ca intake (mg)	RNI 700 LRNI 400	588.0	581.0	490.0	RNI 350 LRNI 275	982.0	994.0	875
Fe intake (mg) RNI Fe intake (mg) LRNI	RNI 14.8 LRNI 8	7.6	7.7	6.0	RNI 6.9 LRNI 3.3	6.9	7.8	9.0
Zn intake (mg)	RNI 7 LRNI 4	6.5	8.4	5.7	RNI 5 LRNI 4	6.5	8.0	7.4
Salt intake (g)	< 6	5.51	5.70	4.80	≤ 2 / ≤ 3	6.22	6.37	6.46

[34] Guideline nutrient intake for energy is EAR; for NMES, NSP, fat and saturated fat is population average DRV; for protein and all micronutrients except salt is RNI; for salt is NHS recommended upper limit.
[35] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.
[36] WHO recommendation adopted by NHS UK
[37] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old.
[38] Updated SACN recommendation (2015)
[39] This is the RNI for protein for children aged 1 to 3 years; increasing to 19.7 g/d for children aged 4 – 6 years (stage 2 and 3)

There was a negative change in preference to bell pepper, from 'like' to 'dislike'. Thoughts regarding the 5 a day message changed from 'just right' to 'a bit too much'; there was a slight increase in knowledge of portion sizes from 3/5 to 4/5 correct. There was an increase in frequency of baking, soup making, and using recipes (from books or own recipes).

8.4 Family 4

Figure 8.4 contains data relating to the dietary intake of the mother and child from 'Family 4'. Parent intake of fruit decreased, while vegetable intake increased over the duration of the study. Overall, combined intake decreased by 16 g/d. Energy intake increased over the duration of the study but was below the EAR at all stages. NME sugar and saturated fat (% of total energy intake) decreased over the duration of the study but was higher than the recommended no more than 11 % of total energy intake at all stages (17.7 % and 14.6 % respectively). Protein intake was lower than the RNI at baseline and stage 2 but had increased by stage 3. NSP intake was lower than the recommended minimum 18 g/d at all stages. Vitamin A intake was lower than the RNI at stage 2 and 3. Folate intake was lower than the RNI at baseline but by stages 2 and 3 intakes were above the RNI. Iron intake increased over time but was lower than the LRNI (8 mg/d) at baseline and stage 2 and lower than the RNI at stage 3. Zinc was below the RNI at all stages. Sodium was above the recommended maximum 6 g/d at stage 3.

Child intakes of fruit and vegetables increased from baseline to stage 2 but decreased at stage 3, with no intake of vegetables and only 16 g/d fruit. Energy intake increased over time and was above the EAR at all stages. CHO intake (% total energy intake) was above the EAR at stage 3; NME sugar was very high at all stages, increasing to 28.7 % by stage 3. NSP intake decreased over the duration of the study. Fat (% total energy intake) decreased over the duration of the study to 30.9 % of energy intake; saturated fat was also decreased over the duration of the study. Vitamin A intake was below the RNI at baseline and stage 3. Iron intake was below the RNI at stage 2 and stage 3. Zinc was below the RNI at all stages. Sodium intakes were above the recommended maximum intake at all stages. There was no change in parental fruit and vegetable preferences. There were some changes in the child preferences from 'really dislike' to 'dislike' but the parent did not report that the child liked any of the fruit or vegetables listed at either stage. At both stages the parent was aware of the 5 a day message and felt it was 'a bit too much'. Knowledge of portion sizes increased from 3/5 to 5/5 over the duration, however intakes did not increase. The parent reported rarely making any foods from recipes, rarely baking or making soup and rarely or never tasting new fruits and vegetables.

Table 8.4: Dietary data from lower SES Family 4

Food or nutrient	Guideline intake Adult[40]	Adult Baseline	Stage 2	Stage 3	Guideline intake child	Child Baseline	Stage 2	Stage 3
Fruit intake (g)[41]	-	70	10	6	-	0	56	16
Veg intake (g)	-	2	0	50	-	4	22	0
Total fruit and veg[42] (g)	≥ 400	72	10	56	-	4	78	16
Daily portions	≥ 5				-	-	-	-
Variety fruits over 5 day period	-	1	1	1	-	0	3	1
Variety veg over 5 day period	-	1	0	3	-	1	1	0
Energy intake (kcal/kJ)	~ 1940/ ~ 8,109 [43]	1514	1290	1872	1,198 / 5,008	1429	1268	1700
CHO intake (% of total energy)	~ 50	56.5	54.6	49.4	50%[44]	52.7	48.3	57.7
NMES intake (% of total energy)	≤ 11	23.3	18.6	17.7	-	24.7	21.3	28.7
NSP intake (g)	≥ 18	7.30	6.40	8.70	-	5.50	5.20	4.20
Fat intake (% of total energy)	~ 35	33.7	32.1	36.2	-	36.9	36.8	30.9
Sat fat intake (% of total energy)	≤ 11	15.1	15.0	14.6	-	16.6	17.3	11.8
Protein intake (g)	45	36.8	41.2	65.2	14.5/19.7[45]	37.4	46.4	47.4
Vitamin A intake (µg)	RNI 600 LRNI 250	621.0	574.0	551.0	RNI 400 LRNI 200	377.0	571.0	313
Folate intake (µg)	RNI 200 LRNI 100	167	206	210	RNI 70 LRNI 50	167	144	234
Vit C intake (mg)	RNI 40 LRNI 10	137.1	97.5	67.9	RNI 30 LRNI 8	70.7	116.8	220.8
Ca intake (mg)	RNI 700 LRNI 400	737.0	900.0	855.0	RNI 350 LRNI 275	692.0	863	1010
Fe intake (mg) RNI Fe intake (mg) LRNI	RNI 14.8 LRNI 8	6.0	6.0	8.3	RNI 6.9 LRNI 3.3	7.9	5.5	6.4
Zn intake (mg)	RNI 7 LRNI 4	3.8	4.5	6.4	RNI 5 LRNI 4	3.4	4.9	4.3
Salt intake (g)	< 6	5.55	4.03	7.32	≤ 2 / ≤ 3	4.96	5.88	5.88

[40] Guideline nutrient intake for energy is EAR; for NMES, NSP, fat and saturated fat is population average DRV; for protein and all micronutrients except salt is RNI; for salt is NHS recommended upper limit.
[41] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.
[42] WHO recommendation adopted by NHS UK
[43] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old.
[44] Updated SACN recommendation (2015)
[45] This is the RNI for protein for children aged 1 to 3 years; increasing to 19.7 g/d for children aged 4 – 6 years (stage 2 and 3)

8.5 Family 5

Figure 8.5 contains data relating to the dietary intake of the mother and child from 'Family 5'. Parent intake of both fruit and vegetables increased over the duration of the project, with a total combined increase of 39 g/d.

Table 8.5: Dietary data from lower SES Family 5

Food or nutrient	**Guideline intake Adult[46]**	**Adult Baseline**	**Stage 2**	**Stage 3**	**Guideline intake child**	**Child Baseline**	**Stage 2**	**Stage 3**
Fruit intake (g)[47]	-	141	34	170	-	98	61	86
Veg intake (g)	-	54	86	64	-	12	52	30
Total fruit and veg[48] (g)	≥ 400	195	120	234	-	110	113	116
Daily portions	≥ 5				-	-	-	-
Variety fruits over 5 day period	-	4	3	3	-	3	4	2
Variety veg over 5 day period	-	4	5	3	-	2	2	1
Energy intake (kcal/kJ)	~ 194049 / ~ 8,109	1417	1481	1450	1,198 / 5,008	1245	1272	1152
CHO intake (% of total energy)	~ 50	50.5	45.6	52.6	50%[50]	36.2	42.5	47.5
NMES intake (% of total energy)	≤ 11	7.5	6.9	10.4	-	5.8	3.8	9.2
NSP intake (g)	≥ 18	12.10	8.20	9.0	-	3.00	4.3	4.3
Fat intake (% of total energy)	~ 35	32.3	40.5	30.2	-	44.0	42.3	34.3
Sat fat intake (% of total energy)	≤ 11	11.1	13.7	12.1	-	19.2	18.7	15.2
Protein intake (g)	45	58.3	51.1	60.6	14.5/19.7[51]	58.2	47.4	51.4
Vitamin A intake (µg)	RNI 600 LRNI 250	502.0	825.0	373.0	RNI 400 LRNI 200	495.0	869.0	373.0
Folate intake (µg)	RNI 200 LRNI 100	210	172	172	RNI 70 LRNI 50	124	109	179
Vit C intake (mg)	RNI 40 LRNI 10	51.4	46.3	42.7	RNI 30 LRNI 8	26.4	24.4	60.3
Ca intake (mg)	RNI 700 LRNI 400	610.0	607.0	782.0	RNI 350 LRNI 275	681.0	550.0	779.0
Fe intake (mg) RNI Fe intake (mg) LRNI	RNI 14.8 LRNI 8	9.5	6.6	6.4	RNI 6.9 LRNI 3.3	5.7	4.7	5.3
Zn intake (mg)	RNI 7 LRNI 4	7.4	6.2	7.2	RNI 5 LRNI 4	6.7	5.5	6.3
Salt intake (g)	< 6	3.90	3.51	4.76	≤ 2 / ≤ 3	4.54	3.57	4.31

[46] Guideline nutrient intake for energy is EAR; for NMES, NSP, fat and saturated fat is population average DRV; for protein and all micronutrients except salt is RNI; for salt is NHS recommended upper limit.
[47] Fruit drinks, including juice, were not included as a portion of fruit for the purpose of this analysis.
[48] WHO recommendation adopted by NHS UK
[49] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old.
[50] Updated SACN recommendation (2015)
[51] This is the RNI for protein for children aged 1 to 3 years; increasing to 19.7 g/d for children aged 4 – 6 years (stage 2 and 3)

Energy intake was below the EAR at all stages. NSP intake was lower than the recommended minimum 18 g/d at all stages. Vitamin A intake was lower than the RNI at baseline and stage 3. Folate intake was below the RNI at stage 2 and stage 3. Calcium intake was below the RNI at baseline and stage 2 but had increased by stage 3. Iron intake was below the RNI at baseline, and below the LRNI at stages 2 and 3. Zinc intake was below the RNI at stage 2.

Child fruit intake decreased and vegetable intake increased; in total there was a combined increase in intake of 6 g/d, but variety of fruit and vegetables decreased. Energy intake was below the EAR at stage 3. Saturated fat intake decreased over the duration of the study but was still higher than the recommended no more than 11 % total energy intake by stage 3 (15.2 %).

Vitamin A intake was below the RNI at stage 3. Vitamin C intake was below the RNI at baseline and stage 2 but had increased by stage 3. Iron intakes were below the RNI at all stages and salt intake was above the recommended maximum intake at all stages.

There was a change over time to the response to the positive statements, with statements 6.8 “good choice of fruit in local shops”, 6.9 “good choice of vegetables in local shops”, 6.10 “the quality of fruit in local shops in good” and 6.11 “the quality of vegetables in local shops in good” changing from ‘strongly disagree’ or ‘disagree’ to ‘neither agree nor disagree’. Statement 6.12, “it can be difficult to cook fruit and make it tasty” changed from ‘strongly disagree’ to ‘strongly agree’. There was a positive change in adult’s preference of melon from ‘dislike’ to ‘like’. There was a positive change in the child’s preference to pear (‘dislike’ to ‘really like’) and apple (‘neither like or dislike’ to ‘like’) and a negative change to preference in banana and cauliflower (from ‘really like’ to ‘neither like or dislike’). Of fruits not previously tasted, melon kiwi and pineapple were ‘really disliked’ and Satsuma was ‘really liked’ by stage 3. The parent had good knowledge of portion sizes (guessing all correctly) at both stages. There was no change to frequency of cooking or trying new fruits and vegetables.

9 Discussion Part 1: A summary of findings

This research involved recording and analysing dietary intake, knowledge and behaviours of parents and children at three time points over an 18-month duration, comparing data from those who attended council sector nurseries in Edinburgh's lowest socio-economic areas to those who attended council sector nurseries in more affluent socio-economic areas. Focus was placed on mean intake (g/d) and variety (over a five day period) of fruit and vegetables, mean energy intake (kcal/kJ), mean intake from energy yielding nutrients (CHO, NME sugar, fat, saturated fat as % energy intake; protein intake as g/d), mean NSP intake (g/d) and mean intake of selected micronutrients (mg/d or μg/d). The micronutrients selected for analysis were vitamins A, folate and C, and minerals calcium, iron and zinc. Sodium was also included because research from other dietary studies (Rustin et al, 2004; Nelson et al, 2007; Gregory et al, 1995) indicates that intakes are often higher than the recommended maximum 6 g/d for adults and 2-3 g/d for children, aged three and four respectively (NHS, 2014).

In addition to summarising the key findings in relation to the research questions in section 2.3 (9.2), baseline data was compared to the findings from other dietary surveys, and to Dietary Reference Values (Department of Health, 1991) for adult females aged 19 to 50, and for children aged 1 to 3 years (sections 9.1) and 4 to 6 years (longitudinal data) (section 9.2.2). The Lower Reference Nutrient intake (LRNI) for adult females was addressed when observing the results for iron intake. In 2011, the Scientific Advisory Committee on Nutrition (SACN) released updated recommendations for energy that included an EAR for each year of age, and in 2015 the committee distributed updated guidelines for the breakdown of energy, which included a change from NME sugar to 'free sugar', and a reduction of sugar intake (as % total energy intake) from 11 % to 5%. The guideline for NSP was replaced with a guideline for dietary fibre intake, which includes a recommendation for intake (g/d) for all ages (SACN, 2015). The updated DRV's for energy (SACN 2011) and new guidelines for free sugar and fibre intakes (SACN 2015) have been mentioned where appropriate in this chapter.

Longitudinal results should be viewed with caution, as a high dropout rate led to a lower than desired sample size by stage 3 (n=17), with 12 families from the higher SES group and five families from the lower SES group remaining. The absence of significant results when comparing lower and higher SES groups at stage 3 is possibly due to this.

Socio-economic status of each family was determined based on residential and nursery postcode, and on the % Free School Meals (FSM) provided to the school(s) attached to the nursery that the child attended. Because of the demographic spread of all participants (across 22 wards ranging from very high Scottish Indices of Multiple Deprivation (SIMD) to very low Scottish Indices of Multiple Deprivation (SIMD) ranking), this baseline data is assumed to be representative of parents with children in a council funded nursery. However, it is important to note that the SIMD identifies deprived areas, not individuals. Not everyone living in a deprived area are themselves deprived, and not all deprived people live in deprived areas; according to 2012 data, of the 742,200 people living in deprived areas in Scotland, just under a third (31.3%) were income deprived (Scottish Government, 2012). Therefore a better understanding of socio-economic status of participating families may have been determined if the questionnaire had asked for financial information, employment history of family members, which would have been required for UK Office for National Statistics socio-economic classification of participants, employment or family earnings. All participants in the Pip study were females of childbearing age. Parent's were not asked for their date of birth; had this data have been collected, comparisons could have been made between adults in different age brackets.

9.1 Comparing the findings of the Pip study at baseline to other dietary studies

The following section compares the key findings of the Pip study at baseline to other dietary surveys, with particular reference to the following dietary surveys:

1. The National Diet and Nutrition Survey (NDNS); adults aged 18 to 65 years, 2004 (data used for adults aged 18 to 49 years only) (Rustin et al, 2004)
2. Food Standards Agency Low Income Diet and Nutrition Survey; adults aged 18 to 49 years (Nelson et al, 2007)
3. The National Diet and Nutrition Survey (NDNS), 1995; children aged 1.5 to 4.5 years (Gregory et al, 1995)

4. Food Standards Agency Low Income Diet and Nutrition Survey; children aged 2 to 10 years[52] (Nelson et al, 2007)

5. Nutritional Intake and Growth in Children; children aged 3 years (Payne and Belton, 1992)

The following two tables (table 9.1 for adults and table 9.2 for children) contain a summary of Pip study data, and data from the comparative studies mentioned above.

Table 9.1; Mean dietary intake of adults from Pip study (baseline), NDNS, LIDNS; SACN recommendations:

Variable	Pip study (all)	Pip study (Higher SES)	Pip study (Lower SES)	NDNS (2004)	LIDNS (2007)	SACN (1991)
Fruit intake (g)	108.2[53]	140	81	76	No data	-
Vegetable intake (g)	151.9	157.5	139	119	No data	-
Total fruit and veg (g)	260.1	297.5	219.5	195	No data	≥ 400[54]
Daily portions	3.3	3.7	2.7	2.4	1.9	≥ 5
Energy intake (kcal/kJ)	1,678.9 / 7,018	1805	1588	1,718 / 7,181	1,601 / 6,692	~ 1940[55] / ~ 8,109
CHO intake (%)	46.9	47.9	45.9	48.5	49.1	~ 50
NMES intake (%)	13.0	15.2	11	11.9	14.1	≤ 11[56]
NSP intake (g)	11.5	11.6	11.5	12.6	10.5	≥ 18
Fat intake (%)	34.6	33.1	36	34.9	35.2	~ 35
Sat fat intake (%)	12.4	11.8	12.9	13.2	13.3	≤ 11
Protein intake (g)	64.7	68.6	61.8	63.7	58.9	45
Vitamin A intake (µg)	737.5	666.6	793	671	743	600
Folate intake (µg)	221.1	233	212	251	208	200
Vit C intake (mg)	95.7	101.4	92.8	81	66.9	40
Ca intake (mg)	767.1	816.5	714	777	696.5	700
Fe intake (mg)	10.2	11.4	9.3	10	8.6	14.8
Zn intake (mg)	7.5	7.9	7.1	7.4	6.9	7
Salt intake (g)	6.1	6.3	6	-	5.38	6

[52] This population age range is much wider than the age at baseline for children in the Pip study (3 years) but was included because of the similar demographic as the Lower SES group.
[53] Fruit drinks, including fruit juice, were not included as a portion of fruit for the purpose of this analysis.
[54] WHO recommendation adopted by NHS UK
[55] This is the 1991 SACN Estimated Average Requirement (EAR) for females aged 19 to 49 years. With the release of the 2011 SACN document Dietary Reference Values for Energy, this recommendation was increased to 2,175 kcal (9,091.5 kJ) in women aged 19 to 34, and 2,103 kcal (8,790 kJ) in women aged 35 to 54 years old. The mean of these two recommendations is 2,139 kcal (8,941 kJ).
[56] Guidelines on sugar intake were changed by SACN (2015) from no more than 11 % total energy from NMES to no more than 5 % total energy from 'free sugar'.

Table 9.2; Mean dietary intake of children from Pip study (baseline), NDNS, LIDNS, P&B; SACN recommendations:

Variable	Pip study	Pip study (Higher SES)	Pip study (lower SES)	NDNS (1995)	LIDNS (2007)	P&B (1992)	SACN (1991)
Energy intake (kcal/kJ)	1,405.1 / 5,873	1,406 / 5,877	1,404 / 5,869	1,160 / 4,869	1,599 / 6,684	1,162 / 4,857	1,198 / 5,008
CHO intake (%)	51.1	52.3	50.1	51.5	51	52.5	39 % not incl. NMES
NMES intake (%) [57]	17.9	19.5	16.6	19.3	16.9	19	-
NSP intake (g)[58]	8.3	8.9	7.8	6.2	9.65	10.5	-
Fat intake (%) [59]	34.6	33.6	35.6	35.8	35.6	35	-
Sat fat intake (%)	14.6	13.8	15.3	16	14.5	14.5	-
Protein intake (g)	48.9	48.7	49	36.8	52.5	36.5	14.5[60]
Vitamin A intake (μg)	576.8	570.8	581.8	579	630	471	400
Folate intake (μg)	177.5	168.6	185	134	185	110	70
Vit C intake (mg)	104.9	107.1	103	52.2	83.2	41	30
Ca intake (mg)	801.9	795.4	807.3	635	764	592.5	350
Fe intake (mg)	7.2	7.2	7.2	5.6	8.5	6.4	6.9
Zn intake (mg)	5.2	5.3	5.2	4.4	6	4.4	5
Salt intake (g)	4.9	5.2	4.9	3.82	5.18	No data	≤ 2

[57] Guidelines on sugar intake were changed by SACN (2015) from no more than 11 % total energy from NMES (children aged 5 and above) to no more than 5 % total energy from 'free sugar' (children aged 2 and above)

[58] The 1991 DoH DRV's had no recommendation for NSP children under the age of 18 years

[59] There is no guideline for the breakdown of macronutrients as % energy intake until the age of 5, at which point EAR is equal to the adult recommendation

[60] This is the 1991 DoH RNI for protein (g/d) for children aged 1-3 years

9.1.1 Adults

The British Government recommends a minimum intake of 400 g/d fruit and vegetables for adults; a guideline that has been adopted from the joint recommendation from the FAO/WHO Expert Consultation of diet, nutrition and the prevention of chronic diseases (Food and Agriculture Organization, 2015). At baseline, adults from both socio-economic groups consumed significantly less ($p = < 0.05$) than the recommended 400 g per day, although mean intakes at baseline by all participants (260 g/d; 3.3 portions) were greater than the 2004 NDNS intake of 195 g/d (Rustin et al, 2004), and significantly higher ($p = 0.04$) than the LIDNS results of 1.9 portions on average per day (Nelson et al, 2007). More results relating to fruit and vegetable intake can be found in section 9.2.3.

The mean daily energy intake at baseline of participants in the Pip study was 1,679 kcal, which is 86.5 % of the 1991 Department of Health recommendation and 78.5 % of the 2011 SACN recommendation for energy intake. Energy intake may have been underreported (see section 3.4). There was no significant difference between mean energy intake of parents in the Pip study compared with the NDNS (Rustin et al, 2004), and the LIDNS (Nelson et al, 2007) and the EAR (Department of Health, 1991). Breakdown of energy intake in all studies was in line with the recommended proportional breakdown of CHO (50 % of total energy intake) and fat (35 % of total energy intake). Until 2015, the term 'NME sugar' was used by SACN. According to the 1991 Dietary Reference Values, the recommended maximum intake of both saturated fat and NME sugar was no more than 11 % of total energy intake. Mean intakes of saturated fat and NME sugar by parents in the Pip Study at baseline were higher (12.4 % and 13 % respectively) than the recommended intake, which mirrored the findings in the NDNS (13.2 % and 11.9 % respectively) and the LIDNS (13.3 % and 14.1 % respectively) (Rustin et al, 2004; Nelson et al, 2007).

The recommended daily intake for NSP in parents at the time of this research was a minimum 18 g/d (Department of Health, 1991). At baseline, there was no significant difference between mean NSP intake of parents in the Pip study (11.5 g/d) compared with the NDNS (12.6 g/d) (Rustin et al, 2004) and the LIDNS (10.5 g/d) (Nelson et al, 2007). Mean intakes in all studies were lower than the recommended 18 g/d. This may be in part due to the low consumption of NSP rich fruit and vegetables (260 g/d), and particularly parents from the lower SES group (219.5 g), which is significantly lower than the recommended 400 g fruit and vegetables per day (see section 9.2.3). There have been no significant increases in NSP intakes in adult females between the 2004 and the 2008-2009 NDNS (Whitton et al, 2011).

There was no significant difference in intakes of micronutrients in parents in the Pip study compared with the NDNS (Rustin et al, 2004) and the LIDNS (Nelson et al, 2007). Mean intakes of all micronutrients in the Pip project were greater than the recommended RNI with the exception of iron. Mean intakes of iron in all studies were less than the recommended 14.8 mg/d (Pip 10.2 mg/d; NDNS 10 mg/d LIDNS 8.6 m/d). The LRNI for adult females is 8 mg/d. At baseline, 11 of the 48 participants (23 %) consumed less than the LRNI; the minimum intake was 3.2 mg/d. These findings are in line with the findings of the 2008-9 rolling National Diet and Nutrition Survey, which found that more than 20 % of adult females had iron levels below the LRNI (Whitton et al, 2011; Bates et al, 2014). It is possible that the RNI for iron is too high for females menstruating age (SACN, 2010), but with such a high percentage of parents, particularly those from the lower SES group below the LRNI, intakes are concerning. However, a review of studies by Beck et al (2016) found little association between total iron intake and iron status long term. In terms of dietary intervention to improve iron levels, promotion of a diet containing ascorbic acid may enhance non-haem iron absorption, provided substantial amounts of non-haem iron rich foods are consumed (Beck et al, 2016). The combination and timing of foods and drinks that enhance (containing ascorbic acid) and inhibit (containing phytic acid, soy protein, polyphenols, calcium) iron uptake may improve iron levels (Sandstrom, 2001; Fairweather-Tait, 2004). The type of iron consumed (haem *versus* non – haem) appears to be a more important determinant of iron status than total dietary intake as haem iron is 2-6 times more available for absorption than non-haem iron (Beck et al, 2014; SACN, 2010); in cross sectional studies, only meat intake has been positively associated with higher serum ferritin concentrations (Beck et al, 2014). However, possible links have been identified between red meat intake and colorectal cancer, which should be considered when promoting red meat intake (SACN, 2010).

Supplementation throughout childhood and in adulthood for females may be beneficial for those who have or have had iron deficiency anaemia, however an improved understanding of the possible adverse effects of iron supplements on iron replete children and pregnant women is required (SACN, 2010). Supplementation of ascorbic acid should also be considered (Sandstrom, 2001). Participants in the Pip Study were not asked if they took vitamin and mineral rich supplements. This may have given valuable data regarding additional intake of micronutrients. For example, the National Diet and

Nutrition Survey 2008/9 – 2010/12 collected data regarding dietary supplements and found that 32 % of women aged 19 to 64 years took some form of supplements. The intake of these supplements made little difference to the mean intakes with the exception of iron containing supplements for women aged 19 to 64 years, which increased the mean intake of total iron by 21 %. However, this research also indicates that participants who took iron supplements had higher intakes of iron from foods than those who did not (Bates et al, 2014). Findings from Sheehy et al (2008) found that 23 % of children were taking a dietary supplement, with higher proportions in younger children, the most common being multivitamins and cod liver oil. Data such as this may have impacted on the total mean intake of micronutrients reported in the Pip study. Fortification of foods such as flour and infant formula has been the main approach used to improve iron intakes in the UK, however evidence suggests that this has not been successful in improving iron status (SACN, 2010). Further research is required to determine if fortification can be an effective tool for increasing iron intake and ferritin levels in susceptible populations.

Government recommendations for salt intake in adults are no more than 6 g/d, or 2.4 g/d sodium (NHS, 2014), as high intake is considered a risk factor for hypertension, which is linked to cardiovascular disease and stroke (Hendriksen et al, 2014; British Heart Foundation, 2014). Mean reported salt intake for all parents participating in the Pip study at baseline was 6.1 g/d, which was not significantly different to the findings from the LIDNS (5.38 g/d) (Nelson et al, 2007). It is noted that there are more accurate methods for estimating salt intakes than through dietary analysis; the sodium content in recipes for both processed and home-cooked foods is highly variable which can lead to misreporting of salt added during the cooking process and at the table by the participant when a dietary record method is used. Nutritional analysis software often does not contain the nutrient composition for all fast foods or branded pre-packaged products that are known to be high in salt (McLean, 2014). Mattes and Donnelly (1991) estimated that 77 % of daily sodium intake comes from processed foods.

Regarding the Pip Study diet diary analysis, many brand names of processed and pre-packaged foods, which are high in sodium, were not available in the WinDiets program at the time of analysis. In these incidences, standard recipes in WinDiets were used, which may have provided a less accurate intake of sodium. A 24-hour urine analysis is the preferred method for accurately analyzing sodium intake, and as such this method is used in a number of national dietary surveys, including the National Diet and Nutrition Survey: Assessment of Dietary Sodium (Bates et al, 2016). However, this method is also time consuming and inconvenient for participants, and there is no procedure to determine the accuracy of each urine collection and analysis (McLean, 2014; Rhodes et al, 2013). A study by Rhodes et al (2013) compared reported intakes using the USDA Multiple Pass Method compared with results of a 24 hour urinary analysis and found that reporting accuracy was 0.93 for men and 0.90 for women, concluding that the Multiple Pass Method is a valid tool for estimating sodium intake in adults at population or group level (Rhodes et al, 2013). This indicates that there are some dietary assessment methods that can provide accurate data if carried out by trained interviewers. According to the National Diet and Nutrition Survey: Assessment of Dietary Sodium (2014), in 2014 mean estimated salt intake for adults in Scotland was 7.8 g/d; 8.6 g/d for men and 6.9 g/d for women (Bates et al, 2016), which is not significantly different to the reported intakes reported by adult females in the Pip Study (6.1 g/d) even with the different methodologies for data collection.

9.1.2 Children

Although over recent years there has been an increasing amount of research measuring actual portion sizes consumed by children, so that these can be used in dietary surveys in place of the recommendations (Wrieden et al, 2008; Foster et al, 2008; More & Emmett, 2014), and there are guidelines currently available (British Nutrition Foundation, 2015), there is no official Government recommended daily intake for children under the age of five years. At baseline, the mean intake of fruit and vegetables was 203.9 g/d, or 2.5 “adult” portions; higher than the LIDNS, which found that fruit and vegetable portions consumed daily were lowest in Scotland, with children consuming an average of 1.5 “adult” portions per day (Nelson et al, 2007).

According to the 1991 Department of Health (DoH) guidelines, the mean EAR for males and females aged three was 1,198 kcal/d (5,012 kJ). At baseline, mean energy intake of children participating in the Pip study was 1,405 kcal/d (5,878.5 kJ). The difference between the Pip study and other studies was not significant, and there was no difference in mean intake between the higher and lower groups. It should be noted that the cohort in the LIDNS were children aged 2 to 10 years (Nelson et al, 2007), and therefore energy intake could be expected to be greater. In 2015, SACN developed a CHO guideline of 50 % total energy intake for children from the age of 2 years. Findings from the Pip study show that at baseline, CHO intake was 51 % energy intake. These findings are not significantly different from the NDNS (51.5 %) (Gregory et al, 1995), Payne & Belton, 1992 (52.5 %) or the LIDNS (51 %) (Nelson et al, 2007). NME sugar intake (% of energy intake) in children in the Pip study (17.9 %) was similar to the findings in the NDNS (was 19.3 %) (Gregory et al, 1995), the LIDNS (16.9 %) (Nelson et al, 2007) and the Payne & Belton study (19 %). Reported intakes in the Survey of sugar intake among children in Scotland were not significantly different; 15.8 % of total energy intake in the 3 to 7 year old age bracket. High intake of NME sugars have been linked to increased likelihood of and dental caries (Gregory et al, 1995; Sheehy et al, 2008) and childhood obesity (Ludwig, 2001), however Gibson found an inverse relationship between a high NME diet and energy density in children (Gibson, 2000). There was no significant difference between % total energy intake from fat in the Pip study and the other studies. Mean % intake at baseline from saturated fat for children participating in the Pip study was 14.6 % which was not significantly different to the findings from the NDNS (16 %) (Gregory et al, 1995), LIDNS (14.5 %) (Nelson et al, 2007), and Payne & Belton (14.5 %). The mean intake in all studies was greater than the recommended maximum 11 % of total energy intake from saturated fat (SACN 2015), which is concerning as dietary habits and taste preferences are formed in the early years (Savage et al, 2007). Intake of a high fat diet has been linked to childhood obesity due to the high energy density of high fat foods, and the low satiety, which induce passive over-consumption (Gibson, 2000). The RNI for protein is 14.5 g for children aged 1 to 3 years and 19.7 g for children aged 4 to 6 years. Mean intake was significantly greater than the RNI ($p = < 0.05$). There was no significant difference in intake between the Pip study and the other studies; in all studies intake was greater than the RNI.

At the time of this research, there was no recommended intake for NSP for children under the age of five, although COMA (Department of Health, 1991) recommended that NSP intakes should be ‘proportionally lower in line with their smaller body size’. In 2008, the School Food Trust recommended a minimum 4.2 g/d for primary aged children. At baseline, mean NSP intake for children participating in the Pip study was 8.3 g, which was not significantly different to 6.2 g in the NDNS (Gregory et al, 1995), 9.65 g in the LIDNS (Nelson et al, 2007) and 10.5 g in the Payne & Belton study. There was no significant difference between mean Vitamin A, folate, Vitamin C, Calcium, Iron and Zinc intakes in children in the Pip study compared with the NDNS (Gregory et al, 1995), LIDNS (Nelson et al, 2007), and the Payne & Belton study. Mean intakes of all micronutrients in the Pip study were greater than the RNI. There was a marginal difference between the Pip study and the RNI for folate ($p = 0.084$). Mean Vitamin C intake for children participating in the Pip study was significantly greater than the RNI ($p = 0.05$). At baseline, mean intake of iron in the Pip study was 7.2 mg/d. Findings were similar to the LIDNS (8.5 mg) (Nelson et al, 2007), whereby in both studies mean intakes were greater than the RNI, which is contrary to the findings from the NDNS (5.6 mg) (Gregory et al, 1995), and the Payne & Belton study (6.4 mg), where mean intakes were lower than the RNI. The LRNI for children aged 3 is 3.7 mg/d. No children in the Pip study reported iron intakes below the LRNI. It may have been beneficial to take data regarding supplement intake, which in turn may have impacted on the overall nutrient intake of the participating children (see section 9.1.1). The National Diet and Nutrition Survey 2008/9 – 2010/12 (Bates et al, 2014) found that 15 % of children aged 18 months to three years, and 17 % of children aged four to 10 years had taken at least one supplement during the four-day recording period. In addition, 21 % of children aged 18 months to three years and 27 % of children aged four to 10 years reported taking supplements over the previous year, the most common types being fish oils and multivitamins with or without minerals.

Government recommendations are that children aged 3 consume no more than 2 g/d salt, or 0.8 g/d sodium, increasing to 3 g/d salt, or 1.2 g/d sodium, at age 4 to 6 years (NHS, 2014). The mean salt intake recorded in the Pip study (4.9 g/d) was not significantly different to the NDNS (3.8 g/d) (Nelson et al, 2007), or the LIDNS (5.2 g/d) (Nelson et al, 2007) even though the methodology used was different (see section 9.1.1). Mean intakes in all studies were greater than the recommended maximum 2 g salt per day. Intakes in the Pip study increased over the duration of the study to 5.7 g/d. These findings mirror other findings such as Schreuder et al (2007) that intakes of salt in children are unnecessarily excessive. Excessive intakes of both salt and saturated fat in children are possibly related to intake of processed, pre-packaged and junk foods. Food Surveys have indicated that children consume a high proportion of processed food both in the home and outside. A systematic review of surveys in the United States showed that the proportion of foods that children consumed from restaurants and fast food outlets increased by 300% between 1977 and 1996 (St-Onge et al, 2003). Recording salt intake through dietary analysis is known to be a flawed method (see section 9.1.1). Actual sodium intake may be much greater than the amount recorded in this study, due to variability of salt added during the cooking process and at the table. An absence of brand information in the WinDiets program may have also led to underreporting.

9.2 Summary of results in relation to the research questions

9.2.1 Research Question 1: Is there a difference in the balance of the diet at baseline between the parents and children in the 'higher' and 'lower' SES groups?

9.2.1.1 Adults

Research indicates that diet quality follows a socioeconomic gradient, with families from a higher socio-economic status more likely to consume lean meats, fibre rich whole grains, quantity and variety of fruit and vegetables, and a diet richer in micronutrients and families from lower socio-economic groups more likely to consume more refined, processed, nutrient deficient foods (Darmon & Drewnowski, 2008; Giskes et al, 2002). Factors that impact on diet in women from lower SES groups may include the perceived cost of healthy eating and lack of time due to work commitments (Inglis et al, 2005). Results from the national Diet and Nutrition Survey rolling programme (2008-9) also found some evidence of differences in diet and nutrient intake, with those in lower income quintiles tending to have poorer diets, particularly with respect to fruit and vegetable consumption (Whitton et al, 2011; Bates et al, 2014).

At baseline, mean fruit intake of parents from the lower SES group was significantly less ($p = < 0.05$) than parents from the higher SES group (81 g/d compared to 140 g/d). Total mean fruit and vegetable intake in the lower SES group was also significantly lower ($p = < 0.05$) than the higher SES group (219.5 g/d compared to 297.5 g/d). This finding is similar to the NDNS rolling programme, which found that intakes of fruit and vegetables were significantly lower in the lowest income quintile compared to the highest income quintile. Variety of vegetables consumed was significantly greater in the higher SES group (8.9 types over the 5 day period compared to 6.9 in the lower SES group), and variety of fruits was 4.9 over the 5-day period in the higher SES group compared to 3.4 in the lower SES group. Mean energy intake was greater in the parents in the Pip Study from the higher SES group (1,805 kcal compared to 1,588 kcal in the lower SES group). Intakes from the lower SES group were very similar to intakes reported by low-income families in the LIDNS (Nelson et al, 2007), and the NDNS rolling programme (Bates et al, 2014), which found a significantly lower intake of energy in adults from the lower income quintiles. However, results from the Scottish Heart Health Study (1991) identified significantly higher energy intakes in females from the lower socioeconomic population (Bolton-Smith et al, 1991).

The diet of parents from both SES groups was not statistically different in terms of the % total energy intake from carbohydrate and fat, with parents from the lower SES group consuming less % energy from CHO and more % energy from fat. The % energy intake from saturated fat was marginally greater in the lower SES group (12.9 % compared to 11.8 % in the higher SES group); intakes in the lower SES group were similar to findings in both the 2004 NDNS (13.2 % of total energy intake) and the LIDNS (13.3 % of total energy intake). The NDNS rolling programme also found that intakes of saturated fat were higher in women from the lowest income quintile. NME sugar consumption was significantly greater ($p = 0.005$) in the parents from the higher SES group (15.2 % compared to 11 % from the lower SES group). This finding is contradictory to previous suggestion that parents from the lower SES groups have greater intakes of NME sugar (James et al, 1997; Turrell et al, 2003; Darmon & Drewnowski, 2008) and is also contradictory to findings from the NDNS rolling programme, which found a higher % energy intake of NME sugar in the lowest quintile compared to the highest quintile (Bates et al, 2014). Mean intakes of NSP were significantly lower ($p = < 0.05$) than the 1991 Department of Health recommendation of 18 g/d in both groups. There was no difference in intake between groups in the Pip Study, which differs from findings from the NDNS rolling programme, which found a significantly lower NSP intake in the lowest quintile.

With the exception of Vitamin A, mean intakes of all micronutrients were marginally greater in the higher SES group. With the exception of iron, mean intakes of all micronutrients were greater than the RNI in both groups. Mean iron intakes in both groups at baseline were lower than the RNI of 14.8 mg/d, and intakes were lowest in the lower SES group (9.3 mg/d compared to 11.4 mg/d). The LRNI for adult females is 8 mg/d. Of a total of 11 participants who consumed less than the LRNI, eight were from the lower SES group (73 %), meaning that in total, 31 % of the lower SES group consumed less than the LRNI for iron at baseline. These findings are similar to the LIDNS (Nelson et al, 2007), which also found that a high proportion of women aged 19 to 49 years had iron intakes below the LRNI (49% for those aged 19 to 34 years, 52% for those aged 35 to 49 years). Disparities in iron intake between socioeconomic groups were also seen in the NDNS rolling programme; women from the lowest quintile had significantly lower intakes of iron compared to women in the highest quintile (Bates et al, 2014).

9.2.1.2 Children

Population studies have shown differences in social classes with regard to food and nutrient intakes at all ages, with low-income groups having a greater tendency to consume unbalanced diets and have lower intakes of fruit and vegetables (Feunekes et al, 1998). However, parental control over consumption of food at this age is a significant factor in food choice, and research indicates that parental fruit and vegetable consumption, behaviours, attitudes and preferences are the factors most strongly linked with children's food preferences and overall intake of fruit and vegetables (Wardle et al, 2005; Cooke et al, 2007; Patrick & Nicklas, 2005). Analysis of results from the Pip Study questionnaire found a significant correlation ($p = < 0.05$) between parental and child fruit and vegetable preferences in 17 out of 20 items. Other studies, such as Longbottom et al (2002) have found similar significant correlations between parent and child snack choices, including fruit. Parental educational level, which may relate to socio-economic status, and early introduction to fruits and vegetables are also significant predictors (Feunekes et al, 1998; Cooke et al, 2007; Savage et al, 2007). At baseline mean intakes of fruit and vegetables by children were only marginally higher in the higher SES group (222 g/d compared to 189 g/d). Children from the lower SES group consumed significantly fewer vegetables in terms of variety ($p = 0.03$) than children from higher SES at baseline (4.7 items compared to 6.3 items). Variety of fruits consumed was also less in the lower SES group (4.7 items compared to 5.7 items).

There was no significant difference in mean energy intake of children at baseline between lower SES and higher SES groups, with both groups consuming more than the recommended 1,198 kcal. There was no notable difference in breakdown of fat and CHO between groups. Mean saturated fat intake was greater was greater than the SACN guidelines (no more than 11 % of total energy intake) in both groups, and intake was greater in the lower SES group (15.3 % compared to 13.8 %), which is similar to findings by Ruxton et al (1996). Mean NME sugar intake was greater was greater than the 1991 SACN guidelines (no more than 11 % of total energy intake) in both groups, with higher intakes in the higher SES group (19.5 % compared to 16.6 % in the lower SES group). Children from the LIDNS study (Nelson et al, 2007), which focused on low-income families, also consumed less NME sugar than children in studies that focused on a generic population (Gregory et al, 1995; Payne and Belton, 1992); 16.9 g/d compared to 19.3 g/d and 18 g/d respectively. These findings also mirror the Pip Study parental dietary intake (section 9.2.1.1). However, these results differ from the Survey of Sugar

Intake among Children in Scotland (Sheehy et al, 2008) who found a higher proportion of food energy from NME sugar in the more deprived quintiles (16.3 % in the least deprived quintile compared to 18.4 % in the most deprived quintile), with a higher intake of NME sugar from non-diet soft drinks, although these results are for a wider age range (3 to 17 years). There was no difference in mean protein intake at baseline between SES groups, with both groups consuming significantly more than the RNI ($p = < 0.05$). The lower SES group had lower mean NSP intake at baseline (7.8 g/d compared to 8.9 g/d in the higher SES group), which may be related to the low intake of fruit and vegetables in the lower SES group (see section 9.2.3.2).

Mean intakes of all micronutrients were similar in both groups at baseline and were greater than 100 % of the RNI for all micronutrients in both groups, including iron. These findings differ from a study by Ruxton et al (1996), who found that school aged children in the lower SES group had significantly lower daily intakes of many micronutrients, although as with the Pip study intakes of all micronutrients were greater than the RNI. None of the children in the Pip study reported intakes below the LRNI and intakes of iron were similar between SES groups. These findings are contrary to findings by Gregory et al (1995) and Lozoff et al (2006) who found disparity between intakes of iron in children from different socio-economic groups; a review of findings from the 1995 NDNS survey found that low iron intakes due to over dependence of milk in young children was linked to low blood ferritin levels, more prevalent in children from lower socio-economic groups (Thane et al, 2000). Salt intakes were significantly greater than the recommended 2 g/d in both groups; there was no difference in mean intake of salt between groups.

9.2.2 Research Question 2: Is there any significant change to the dietary intake (positive or negative) over the duration of the research period in either group?

9.2.2.1 Adults

The following summary of findings is based on the dietary intakes of families who participated in the Pip study at all stages (n=17; lower SES group n=5; higher SES group n=12). Participation diminished significantly over the research period, therefore stage 3 results should not be considered as representative for the relevant populations. Notably large changes in dietary intake were not always significant; the small sample size by stage 3 may have prevented any significant differences from being detected. Results relating to fruit and vegetable consumption can be found in section 9.2.3.

Overall, there was an improvement in dietary intake in the 17 parents who participated in the Pip study at all stages, and particularly in those from the lower SES group. By stage 3, mean energy intake had increased from 1.768 kcal to 1,824 kcal. At no point throughout the research period did parents from either group consume a mean intake of more than 1,940 kcal, which is the 1991 Department of Health recommended intake for women aged 19 to 50 years. At baseline, mean energy intake in the higher SES group was significantly greater ($p = < 0.05$) than in the lower SES group (1,424 kcal compared to 1,911 kcal); however by stage 3 there was a decrease in energy consumed by the higher SES group and an increase in energy consumed by the lower SES group meaning that there was no longer a significant difference in the energy consumed. In terms of CHO and fat, the % energy breakdown was not significantly different to SACN guidelines throughout the research period. There was an overall decline in NME sugar consumption from baseline to stage 3; consumption in the higher SES group reduced from 15.1 % to 12.3 % and consumption in the lower SES group reduced from 13.5 % to 10.6 % which is below the recommended maximum intake of 11 % of total energy. Mean saturated fat intake was greater than the recommended maximum intake of 11 % of total energy at all stages, and increased marginally ($p = 0.079$) over the duration of the study, from 12.4 % to 13.7 % in the higher SES group and an increase from 12.7 % to 14.5 % in the lower SES group. Mean NSP intake increased from baseline to stage 3; there was an increase of 3 g/d in the higher SES group and an increase of 4 g/d the lower SES group; however mean intakes at stage 3 were still significantly lower than both the 1991 and the 2015 SACN guideline for NSP intake (18 g/d).

Mean intakes of all micronutrients increased from baseline to stage 3, and all mean intakes of all micronutrients, with the exception of iron, were above the recommended nutrient intake at all stages. Iron intake in the lower SES group was significantly lower ($p = < 0.05$) than the RNI, and lower than the higher SES group at baseline (7.8 mg/d compared to 11.5 mg/d); however intakes increased by 3.7 mg/d in the lower SES group to 11.5 mg/d by stage 3, which was similar to the intake of the higher SES group (11.8 mg/d) and no longer significantly lower than the RNI. Although mean intake at stage 3 was still lower than the RNI for iron, the increase over time is positive. Of the 17 parents who participated at baseline and stage 3, four had intakes less than the LRNI at baseline; three of which were from the lower SES group. The lowest intake was 6 mg/d. Only one parent at baseline consumed more than the RNI. By stage 3, the number of parents consuming less than the LRNI had decreased to two; both were from the lower SES group. By stage 3, parents were consuming more than the RNI. Zinc intake was significantly lower ($p = < 0.05$) in the lower SES group, and less than the RNI at baseline (5.6 mg/d compared to 8.3 mg/d); however, intake increased in the lower SES group and decreased in the higher SES group over time, and by stage 3 intakes were the same. By stage 3 mean intakes were greater than the RNI in both groups.

9.2.2.2 Children

The following summary of findings is based on the dietary intakes of families who participated in the Pip study at all stages (n=17; lower SES group n=5; higher SES group n=12). Other than an increase in NME sugar, all reported changes to dietary intake in children in the lower SES group over time were positive. Mean energy intake of children at baseline was 1,486 kcal/d (5,878.5 kJ); by stage 3 there was an overall increase to 1,593 kcal (6,665 kJ), which would be expected as children are growing during this time. Mean fat intakes in the lower SES group at baseline were 39.7 %, which was significantly greater ($p = 0.04$) at baseline than the higher SES group. However, by stage 3, intake in the lower SES group had decreased to 35.4 %. Saturated fat was also higher at baseline in the lower SES group at baseline (16.2 % compared to 14.2 %). This had decreased by stage 3 to 14.1 % in the lower SES group compared to 14.4 % in the higher SES group, however mean intakes were greater than the recommended maximum 11 % of total energy intake at all stages. There was proportional breakdown of energy from CHO at all stages of the research period. Children in the higher SES group consumed more NME sugar than children from the lower SES group at baseline. Intake decreased slightly in the higher SES group and increased slightly in the lower SES group; by stage 3 there was 0.6 % difference between the 2 groups.

At baseline, mean NSP intake in the lower SES group was significantly lower ($p = 0.001$) than the higher SES group (5.8 g/d compared to 9.5 g/d). NSP increased over the duration of the research period to 10.1 g/d in the higher SES group, and to 7.6 g/d in the lower SES group may in part be due to an increase in fruit and vegetable consumption in the lower SES group over the duration of the study. Mean intakes of all micronutrients increased over the study period, which would be expected as children are growing and overall dietary intake is increasing. With the exception of zinc, all intakes were greater than the RNI for children aged 4 to 6 years (DoH, 1991) at stage 3. At baseline and stage 3, mean intakes of all micronutrients were greater than the RNI with the exception of zinc. Mean intake at baseline in the lower SES group was lower than the RNI for children aged 1 to 3 years (5 mg/d). Intakes increased over time; however by stage 3 the mean intake of both groups was less than the RNI for children aged 4 to 6 years, which is 6.5 mg/d (DoH, 1991). Results from the children's data is contrary to studies such as James et al (1997) and Gregory et al (1995) who found disparity in dietary intake based on SES groups; "...this type of diet is lower in essential nutrients such as calcium, iron, magnesium, folate, and Vitamin C than that of the higher SES groups…" (James et al, 1997). Moreover, iron intakes were optimal, and greater than the LRNI in all cases, which is also contrary to the findings of the NDNS (Gregory et al, 1995). At baseline and stage 3, both SES groups consumed excessive amounts of salt. Once again, these findings are not dissimilar to findings by Schreuder et al (2007) that intakes of salt in children exceed the recommended maximum intake of 2 g/d aged 3 and 3 g/d aged 4 to 6 years.

9.2.3 Research Question 3: Is there a significant increase in the grams (g) of fruit and/or vegetables consumed over the duration of the research in either group?

The following section reviews the findings from the Pip study relating to fruit and vegetable intakes at baseline and over the duration of the study, and compares intakes to the findings from the questionnaire relating to barriers to eating fruit and vegetables, knowledge of the five a day message, culinary activity and preferences. It should be noted that fruit drinks, including fruit juice, were not included as a portion of fruit for the purpose of this analysis, and fruits as part of desserts were not considered unless the dessert was made using the raw ingredients. It is also noted that there was difficulty recording accurate fruit and vegetable intake, as researcher relied on the participant providing accurate recipes and/or brands of pre-purchased items, which was not always the case.

9.2.3.1 Adults

At baseline, parents from the higher SES group consumed significantly more fruit (140 g/d compared to 81 g/d; $p = 0.01$), and significantly more fruit and vegetables combined (297.5 g/d compared to 219.5 g/d; $p = 0.02$), than parents from the lower SES group, even though there was no significant differences in responses from the higher and lower SES groups to questions relating to barriers to healthy eating (section 7.1.2), and parents from the lower SES group had better understanding of the portion size message than parents from the higher SES group (section 7.1.4). The majority of parents from both SES groups did not agree with the statements that fruit or vegetables "were too expensive", "took too long to prepare", "did not have a good shelf life", or were "difficult to cook". Significantly fewer parents from the lower SES ($p = < 0.05$) agreed that "choice of fruit and vegetables was good in local shops", however, no parents reported shopping for fruit and vegetables in local shops either at baseline or stage 3, with 70 % of parents purchasing their fruit and vegetables at supermarkets, the majority of whom were from lower SES groups. Research by Pechey and Monsivais (2015) found that parents who purchased from supermarkets purchased a higher percentage of energy from fruit and vegetables regardless of socioeconomic status.

Throughout the research period a number of fruit and vegetables based initiatives were carried out with parents and children from the lower SES group (see table 3.2). There was a minimal increase in fruit consumption in both groups over time, however mean vegetable intake increased by only 13 g/d in the higher SES group and by only 10 g/d in the lower SES group from baseline to stage 3. Increase in intake (g) of combined fruit and vegetables over the duration of the study was greater in the higher SES group, who did not receive free and low cost fruit and vegetables through the Pip Project, and by stage 3 there was a significant difference ($p = 0.05$) between intakes from the higher SES group and lower SES group (355 g/d compared to 234.5 g/d). Mean intakes in the lower SES group were still 165 g/d (2 portions of fruit and vegetables) less than the recommended 400 g/d ($p = < 0.05$) by stage 3. In terms of changes in intake by parents from the lower SES group; Family 1 parent increased her combined mean intake by 238 g/d, and Family 5 parent increased combined mean intake by 39 g/d; however intake by Family 2, Family 3 and Family 4 parents' mean combined intakes decreased over time, indicating that the programme was not effective in improving fruit and vegetable intakes in all parents.

The interventions, and free or low cost fruit and vegetables offered through the Pip Project did not seem to impact on dietary habits parents over the duration of the study; with the exception of one family there was no reported change in the number frequency of baking, cooking, or trying new fruits and vegetables. In contrast; two parents' views on the five a day message changed from 'just right' to 'a bit too much', and even though fruit and vegetables were offered at low cost and all parents were invited to a wide range of cooking classes at no cost, there were some changes to some of the statements relating to barriers, particularly with reference to 'fruit and vegetables cost too much' and 'vegetables take too much time to prepare', with parents changing their view from 'disagree' to 'agree' over time. These findings are consistent with findings from a number of other dietary studies that have identified a greater intake of fruit and vegetables in adults from higher SES groups, who are more likely to consume a higher quantity and variety of fruit and vegetables (Giskes et al, 2002; Scottish Health Survey, 2008; Darmon & Drewnowski, 2008; Bates et al, 2014). There has however been no significant increase in fruit and vegetable consumption in the UK population, even with community based initiatives such as the Pip Project and nationwide programmes such as the 5 a day campaign. The NDNS rolling programme found no significant changes over time in fruit and vegetable consumption, with the exception of salad and raw vegetables (Whitton et al, 2011); the Scottish Health Survey (2008) also found no significant changes in fruit and vegetable consumption between 2003 and 2008, with lowest intakes in the most deprived communities. Further research is required to identify interventions that successfully impact on adult fruit and vegetable intake.

9.2.3.2 Children

During the first five years of life, children are developing eating habits based on the transmission of cultural and familial beliefs, attitudes, and practices surrounding food and eating, and as such, parents are instrumental in shaping a child's food preferences (Savage et al, 2007). As discussed in section 9.2.1.2, results from the Pip questionnaire do show a significant correlation between parental fruit and vegetable preferences and perceived child fruit and vegetable preferences in 17 out of 20 food items, the three exceptions being pineapple, cucumber and bell peppers. Data from the Pip study looking at baseline (August 2005) to stage 2 (March 2006) shows a marginal but not significant increase in both fruit and vegetable consumption in the lower SES group (those who received the free fruit); however, the same increases were seen in the higher SES group. Research by Ransley et al (2007) which evaluated the impact of the school fruit and vegetable scheme (SFVS) on 3,703 children aged 4 to 6 years in the North of England, found a significant increase in fruit intake after 3 months, with a still significant but slightly reduced impact at 7 months. There was however no change in vegetable consumption over the duration of the SFVS research period.

In terms of the families who completed all three stages; at baseline, intakes of fruit and vegetables in children were considerably lower in the lower SES group (120 g/d compared to 206 g/d). There was an increase seen on both fruit and vegetable consumption in children from both groups, with a greater increase over time in the lower SES group (82.4 g/d) than in the higher SES group (38.2 g/d). Although at stage 3 intakes were still greater in the higher SES group (253 g/d compared to 203 g/d), the disparity in intake between groups was greatly reduced. This result is promising, although the sample size is small. On an individual level, of the five remaining participants from the lower SES group at stage 3, three out of five children increased fruit intake, and four out of the five children increased their vegetable intake. All five children increased their combined fruit and vegetable intake over the duration of the study. By stage 3, there was also an increase in the number of fruits and vegetables 'liked and 'really liked' by four out of the five children from the lower SES. As food choices are most likely made by the parents, it may not be possible for children at preschool age to guide their dietary intake even if fruit and vegetables are enjoyed. Research was reliant on the parents' opinion of child preferences. Research carried out with the participating children to determine their individual knowledge and acceptance of the fruits and vegetables provided over time may have been more valuable for gaining a true understanding of the impact of the Pip Project on fruit and vegetable preferences. Children from the lower SES group of the Pip study were consuming 2.5 portions, and children from the higher SES group were consuming 3 portions by age 5 (2007). Recent data from the Health Survey for England (2014) shows promising increases in fruit and vegetable intake in children at school age; the proportion of children aged 5-15 eating 5 or more portions of fruit and vegetable increased from 16% in 2013 to 23% in 2014, and the mean number of portions consumed daily in 2014 was 3.5.

9.2.4 Research Question 4: Is there a significant increase in variety of fruit and/or vegetables consumed over the duration of the research in either group?

9.2.4.1 Adults

Research indicates that higher SES groups are more likely to consume vegetables and fruit, particularly fresh, not only in higher quantities but also in greater variety (Darmon and Drewnowski, 2008). However, there was no significant difference in variety consumed between groups in the Pip study at baseline, and no significant change in the variety of fruit consumed by parents from both groups from baseline to stage 3. There was a significant difference in the change over time of variety of vegetables consumed ($p = < 0.05$), due to a marginal increase from the lower SES group and a marginal decrease in variety from the higher SES group. However, of the five parents from the lower SES group who completed all questionnaires and diet diaries, two reported increases in variety of fruit and one reported an increase in variety of vegetables over time; all other parents reported a decrease or no change in variety consumed over time.

9.2.4.2 Children

At baseline, children from the lower SES group consumed a significantly lower variety of vegetables ($p = 0.03$) than children from higher SES at baseline (4.7 items compared to 6.3 items). Variety of fruits consumed was also lower in the lower SES group (4.7 items compared to 5.7 items). Children from the lower SES group increased the mean variety of fruit and vegetables consumed over time, where there was no increase in the variety of fruit consumed and a reduction in the mean variety of vegetables consumed by children from the higher SES group. Although the change is minimal, this increase is promising. However, when looking at individual families there was no consistency, there was an increase in variety of fruits in three of the families and an increase in variety of vegetables in only two of the families; children from the other families reported a decline or no change in variety.

9.2.5 Research Question 5: Is there evidence that the consumption of additional fruit displaces the NME sugars such as soft drinks, confectionery and cakes (if fruit (g) increases, does NME sugar (g) decrease)?

A marginal reduction in NME sugar and a marginal increase in fruit were seen in parents over the duration of the study period, however there is not enough data at stage 3 to demonstrate any significant correlation. There is no evidence that the consumption of fruit in this study displaced other NME sugars in children; intakes of both NME sugar and fruit increased in children in the lower SES group over time. However, further research is required in this area, particularly with children of an older age who make their own snack choices.

9.2.6 Research Question 6: Is there evidence that fruit is consumed in addition to high NME sugar snacks, therefore increasing the total energy intake and subsequently potentially contributing to the obesity epidemic?

Energy intake in parents increased over time, however intakes were not greater than the recommended EAR for parents at any stage. NME sugar intake declined and there was no significant increase in fruit consumption. Energy increase was due to an increase in fat and protein consumption in parents from the lower SES group. Energy intake in children increased over time, which would be expected as children are growing; however intakes were greater than the EAR at all stages in both groups. NME sugar intake decreased over time in all groups except children from a lower SES, whose intake increased over time by

1.4 %, but still consumed less at stage 3 than children from the higher SES group (18.5 % compared to 19.1 %). Research by Gibson et al (2007) found a weak correlation between high NME diets and leanness rather than obesity. Weights were not taken for children participating in the Pip study so it is not possible to determine any correlations between NME intake and weight change.

9.2.7 Research Question 7: Does the consumption of additional fruits displace more wholesome foods such as those that contain protein, calcium, iron and zinc?

A review of the NDNS (Gregory et al, 1995) found that as the concentration of NME sugar increased, intakes of most micronutrients also fell, and concluded that the inverse association of NME sugar with micronutrient intakes is of most significance for the 20 % of children with diets highest in NME sugar (Gibson, 1997). The suggestion of an inverse relationship between high NME sugar intake and low micronutrient intake is concerning, particularly with reference to iron deficiency, which was also prevalent in children who participated in the NDNS (16 % of 1½ to 4½ year olds), and particularly in children from lower socio-economic groups (Gregory et al, 1995). This does not appear to be the case with the Pip study; there was no inverse correlation between iron or other micronutrient intake and NME sugar intake in children. Fruit consumption did not impact protein intake or mineral intake. For adult females, the RNI for protein intake is 45 g/d. Intake at baseline was 57.1 g/d, which was significantly lower ($p = 0.05$) in the lower SES group (57.1 g/d compared to 72 g/d). Over the duration of the study fruit intake increased, and protein intake also increased; by stage 3 there was no significant difference in protein intake between groups. Intake of calcium, iron and zinc also increased. The same increases were observed in the child data; protein and mineral intake in children increased over the research period, as did fruit intake.

9.2.8 Research Question 8: Is there a change in knowledge over time (positive or negative) in parents from either group?

Results from the baseline questionnaire showed that 100 % of parents reported that they were aware of the five a day message, and 68 % of parents felt the message was ‘just right’. With the exception of bell peppers, the majority of parents at baseline were able to correctly determine what was meant by a ‘portion’, with a significantly higher number of parents from the lower SES group likely to correctly guess the correct portion size for melon, banana and strawberry ($p = < 0.05$) at baseline. Regarding data from individual parents from the lower SES group; knowledge of portion sizes increased over time in three families, with the other two parents guessing all correct portion sizes at both stages. This increase in knowledge relating to portion sizes in the lower SES group may not be directly related to the Pip Project interventions, as knowledge also increased in the higher SES group, the NHS 5 a day message was launched in March 2003, and the Health Survey for England (2008) documented an increase in fruit and vegetable intake by adults over the same time period, with intakes increasing from 3.4 portions to 3.8 portions per day over the same time frame as the Pip study.

9.3 Conclusion

Although parents from lower SES groups had greater knowledge of what constituted a portion than the parents from the higher SES group from the outset, and their fruit and vegetable intake did increase marginally over time, intake at stage 3 was significantly lower than parents from the higher SES group, and significantly lower ($p = < 0.05$) than the recommended intake throughout the 20-month research period. It is generally considered that parents from lower SES areas face barriers related to cost, access, availability of food items. However, the findings of this research do not support this theory and indicate that even with the correct knowledge, without the presence of perceived barriers, with access to a supermarket or food store, and with interventions that promoted and provided vegetables and fruit, either free of charge or at low cost, parents still do not consume adequate fruit and vegetables. NME sugar intake decreased but saturated fat intake increased over the duration of the study, with greatest intakes in the lower SES group. Mean intakes of all micronutrients were greater than 100 % of the RNI by stage 3 with the exception of iron, and were greater in the higher SES group, although change over time of folate, calcium, iron and zinc were greater in the lower SES group. Case studies showed no clear pattern in behaviour between the families who completed all 3 stages of the study. Although some dietary improvements were seen, further research is required to determine the types of intervention that would positively impact on fruit and vegetable in parents from lower SES areas. Dietary improvement was seen in the mean energy and macronutrient intake of children from the lower SES group over the duration of the study, with the exception of an increase in NME sugar. Mean fruit and vegetable intake increased the most in the lower SES group, and while mean intakes of all micronutrients increased in both SES groups, the increase was more so in the lower SES group with the exception of Vitamin C, which is a positive indication that the diet was improved over time in those participants who received the Pip intervention.

However, the small sample size means that this data should be reviewed with caution. Further intervention studies are required to identify methods for increasing the fruit and vegetable intake and to reduce the salt, NME sugar and saturated fat intake in children from all socio-economic backgrounds.

10 Discussion (part II): Considerations for future research

Although there was an overall improvement in dietary intake, results indicate that even with multiple interventions offered, there was little change in terms of fruit and vegetable intake in parents over the two-year period. Intake of fruit and vegetables in children from the lower SES group (whose parents whose parents provided data at all three stages of the study) increased by one portion per day, which is promising, however intakes in both adults and children from both SES groups were still lower than the recommended 400 g/d. Food preferences developed during the early years are an important determinant of healthy eating in young children and this is strongly influenced by family (Scaglioni et al, 2011). The age at which healthy eating interventions begin is also a key factor; research from the ALSPAC project suggests that there is a dramatic shift in the amount of NME sugar consumed between the age of 18 months and 3 ½ years of age. In a survey of 863 children, whose parents completed a 3-day diet diary, considerably more energy was derived from non-milk extrinsic (NME) sugar at 43 months (16%) than at 18 months (12%); the ratio of polyunsaturated to saturated fat had increased from 0.26 to 0.33 and fewer children were eating vegetables (Emmett et al, 1996). It is therefore essential that interventions such as the Pip Project are available to target children before poor dietary habits are formed, with more emphasis on family education, and increasing parental knowledge and culinary skills. Nursery schools are an essential community based learning environment that offers support and security to vulnerable families, and are therefore an ideal setting for such initiatives.

Interventions should provide skills, knowledge and resources that are transferable into the home setting. Dietary improvement was seen in the Pip Study, although there are still significant improvements that could be made, including an increase in NSP intake, an increase in both the variety and volume of fruit and vegetables consumed. The Pip Project was not successful in reducing salt, saturated fat and NME sugar intake to an acceptable level. Over the last 40 years, the home environment has changed significantly. Parents are working longer hours; mealtimes are less family orientated and there has been a reduction in the amount of food cooked using fresh ingredients within the home; foods are often pre-packaged for convenience, particularly in lower income families (Hawkins et al, 2008; Carrigan et al, 2006; Patrick & Nicklas, 2005; Smith et al, 2013). Interventions such as the Pip Project will only achieve success if the key health messages and healthy lifestyle changes are adopted and implemented by parents. The following chapter looks at the influence of family behaviours that may have a negative effect on dietary choice, particularly in families from a lower socio-economic demographic, with suggestions for further interventions that may assist in improving the diet of parents and their children.

Interventions aimed at improving children's diet should address the variety of social and physical factors that influence children's eating patterns. Research has demonstrated that children's eating patterns are strongly influenced by characteristics of both the physical and social environment such as parents' education, time constraints, availability of and preference for particular foods, ethnicity and cultural values regarding food types and preparation, parents' beliefs and practices (Patrick & Nicklas, 2005; Scaglioni et al, 2011; Smith et al, 2013). Research indicates that from the age of two years, there is a correlation between the behaviour of parents and their children with regard to dietary characteristics, food preferences, and intake regulation (Skinner et al, 2002). The Pip Project focused on increasing acceptability of a wide variety of fruit and vegetables in children; however if these items were not also considered acceptable by the parents, the likelihood of the intervention continuing in the home setting is low. Interventions should focus more on setting realistic dietary goals that are achievable within the home setting, and should consider the lifestyle, knowledge and food preferences of the parents and other family members. Future interventions should consider tasting sessions and fruit and vegetable based activities for both parents and children.

Mealtime structure is an important influence in related to children's eating patterns; how often families eat together, and whether TV viewing is permitted during meal times can contribute to dietary intake (Patrick & Nicklas, 2005). Children who eat meals with other family members consume a healthier diet than those who eat alone. A study by Neumark-Sztaineret al (2003) found that frequency of eating meals as a family was positively associated with intake of fruit, vegetables, grains, protein and a wide range of vitamins and minerals, and negatively associated with soft drink consumption. Allowing children to only eat at set meal and snack times also encouraged fruit and vegetable consumption (Wyse, 2012). In adolescents, the presence of the family at the dinner meal has been positively associated with consumption of fruit and vegetables (Videon & Manning, 2003). The Pip study may have had a greater impact on overall diet if more educational sessions were offered for parents regarding the importance of family mealtime, portion sizes and balance of meals. More emphasis on cooking skills may have given parents more confidence to prepare healthier food options for the family.

Research suggests that children prefer to eat foods that are most familiar to them (Birch & Marlin, 1982, cited by Patrick & Nicklas, 2005). In a cross-sectional survey of 564 mothers of preschool children, early introduction to fruit and vegetables during weaning was associated with a higher frequency of consumption of these foods in children aged two to six years (Cooke et al, 2004). Results from the ALSPAC study show that early introduction to textured foods was related to a greater variety of foods consumed at the age of 15 months (Northstone et al, 2001). Children who do not have foods introduced at an early age may develop 'neophobia', which is a fear of trying new foods (Rozin, 1976). Repeated exposure to foods has been shown to increase likelihood of acceptance, as has an increase in the variety of foods and food groups that a child is exposed to. For example, exposing children to one vegetable may make other vegetables more easily accepted, as children understand that they are from the same food group (Patrick & Nicklas, 2005). Research indicated that the earlier the exposure the more likely the food will be accepted, and the older the child, the more exposures are required before the food is accepted (Cooke, 2007; Birch et al, 1991).

Research by Baranowski et al found that when fruit and vegetables are readily available and accessible in terms of method of preparation and location, children are more likely to eat them (Baranowski et al, 1999; Nicklas et al, 2001). A study by Wyse (2012) found that preschool children's fruit and vegetable consumption was positively associated with parental fruit and vegetable consumption, fruit and vegetable availability and accessibility within the home. Data collected in the Pip study questionnaire indicated a clear correlation between parental and child fruit and vegetable preferences; in less than 1 % of data, parents reported that a child "liked or really liked" an item that the parent "disliked or really disliked". Over the duration of the Pip study, a reported increase in fruit and vegetable preferences was seen in children. This may be due to exposure in the nursery setting where items are readily prepared for snack. Future interventions should aim at encouraging parents to provide readily prepared healthy food options to encourage children to make healthier snack choices. Suggestions may include provision of pre-washed and chopped fruit and vegetables, located where children can access them, and offered at every meal and snack time.

Although the Pip study demonstrated an overall improvement in dietary intake, children still consumed excessive salt, NME sugar and saturated fat, and not enough NSP, fruit and vegetables. Salt intakes in children increased over time from 4.9 g/d at baseline to 5.7 g/d at stage 3; % energy intake from NME sugar remained high throughout the study.

Saturated fat intake decreased by 2.2 % in children from the lower SES group, but intakes were still higher than the recommended % energy intake. In families where parents are in full time employment, or families where parents do not have the skills or knowledge required to prepare a healthy meal, there is an increasing reliance on convenience foods which often come from fast food establishments, take away restaurants, and the frozen and pre-packaged food sections of the grocery store. Processed foods, either ready-to-eat or pre-packaged and frozen, are generally high in salt, sugar, saturated and trans-fats. A study by the NPD Group (2000) (cited in Patrick & Nicklas, 2004) found that in the USA, time spent preparing meals declined more than 10% from 1994 to 1999. To reverse this trend, future interventions should include up-skilling and educating parents, teaching skills such as how to make healthy, tasty, low cost, easily prepared meals and snacks, and ways to reduce intakes of salt, sugar and saturated fat (Patrick & Nicklas, 2004).

Birch and Fisher (1995) (cited in Patrick and Nicklas, 2005) identified 3 child-feeding patterns: Authoritarian feeding, which attempts to control the child's eating with little regard for the child's choices and preferences; permissive feeding, whereby the child is allowed to consume whatever he or she wants with little or no structure is provided, and choices are limited only by what is available; and authoritative feeding, where adults determine which foods are offered, and children determine which foods are eaten. Authoritarian feeding has been associated with lower intake of fruit, juices, and vegetables (Cullen et al, 2000). When parents restricted children's consumption of foods high in fat and sugar, children were more likely to fixate on these items and consume them even when they were full (Fisher & Birch, 2000). Authoritative feeding has been associated with greater fruit and vegetable availability, higher intake of fruit and vegetables, and lower intake of junk food (Gable & Lutz, 2000).

A study of 812 Latino-American families by Arredondo et al (2006) found that reinforcement and monitoring by parents was associated with healthier eating and increased exercise in children, and that appropriate disciplining styles were associated with healthier eating, while use of authoritarian styles was associated with unhealthy eating. Parents should be encouraged to use more positive reinforcement and monitor their children's health behaviours (Arredondo et al, 2006). Future interventions should consider an introduction of parent counselling both pre-pregnancy and in the early years, as this may help parents to identify and improve their parenting style. In addition, joint parent and child sessions within the nursery environment that encourage exposure to a range of healthier food items may help to improve acceptance of foods, and therefore improve dietary intake.

10.1 Suggestions for future interventions

A number of interventions, and particularly interventions with multiple objectives, have been proven to be effective on improving body composition, dietary intake and healthy knowledge. A multi-disciplinary approach may be more successful at achieving dietary change than a single intervention (Mikkelson et al, 2014). The Pip Project intervention used a multi-disciplinary approach to improve diet in children and their parents. There have been many effective multi-disciplinary interventions such as the Pip Project that have included development of educational materials and resources to increase knowledge of a healthy diet; campaigns that encouraged parental and familial participation; and free or low-cost nutrition related programs for parents (Gortmaker, S. et al, 1999). However, often researchers do not effectively evaluate individual objectives, rather they evaluate the intervention as a whole, which means that there is no ability to determine which aspect of an intervention was successful and which was not. This was the case with the Pip study; overall change was assessed rather than the impact of each individual aspect of the intervention therefore it is not possible to identify which areas of the intervention were successful and which were not. It is also essential that interventions be based on a theoretical foundation, have a suitable sample size and a control group. The Pip Project was not based on a widely used theoretical foundation; rather it followed the ECFI model of 'provide and promote' to overcome perceived barriers to health (the five A's). This Pip study sample size diminishes over time to the extent that it impacted on the ability to identify statistical significance in the results. This also impacted on the ability to have an absolute control group. A meta-analysis of 55 studies by Waters et al (2010) found unexplained likelihood of small study bias, and noted that study and evaluation designs need to be strengthened, and reporting extended to capture process and implementation factors, outcomes in relation to measures of equity, longer term outcomes, potential harms and costs (Waters et al, 2010). The majority of interventions are disadvantaged by their short-term nature and the absence of follow up (Mikkelson et al, 2014). The Pip study had the advantage of following participants for two years; however the negative aspect of this was the high drop-out rate over time as parents' circumstances changed. The following section reviews different intervention methods that could be adopted for future research with examples of their success.

An intervention, consisting of four 30-minute phone calls and accompanying printed resources, was developed in Australia to support parents (n=394) to make changes within their home food environment. The aim of the intervention was to increase the availability and accessibility of fruit and vegetables, to encourage parental role modelling of fruit and vegetable consumption, and to establish supportive family food routines. Fruit and vegetable scores of the children in the intervention group were significantly higher than the control group at 2 and 6 months which suggest that an intervention targeting characteristics of the home environment and delivered by telephone may be an effective way of supporting parents to increase the fruit and vegetable intake of their preschool children (Wyse, 2012). Research by Spring et al (2012), which included remote coaching to improve dietary intake in a sample of 204 adults, saw significant increases in consumption of fruit and vegetable consumption and an increase in physical activity, which were maintained at follow up, indicating that remote coaching by mobile technology combined with financial incentives may be a tool to promote healthy behaviours (Spring et al, 2012).

Future research should be based on a theoretical model of health improvement. The Stages of Change theory is a psychological model developed for the treatment of addictive behaviour, used to assist with identification of readiness to change, and to develop interventions based on the individuals' current stage of change (Heimendinger & Van Duyn, 1995). Success of change is dependent on the type of change being made and the motivation for change (Ogden et al, 2007). Research has shown consistently that the intention to perform a particular behaviour can be translated into actual behaviour. In terms of eating behaviour, research has also shown that the intention to eat healthily is a successful predictor of subsequent behaviour, particularly where the intention is positive (Ogden et al 2007). Various methods can be incorporated into interventions focusing on behaviour change. Many Government Initiatives now develop health campaigns and interventions based on various aspects of the behaviour change model (Weichselbaum et al, 2013). The key elements to successful dietary behaviour change are frequent contact and support, with implementation of commonly used techniques, such as self-monitoring and creation of coping strategies (Avenell et al, 2006). Motivational factors such as ethics, religion, and cost can positively influence change (Ogden et al 2007). Michie et al (2009) carried out meta-analyses of behaviour change interventions from 1990 to 2008. Their study found that interventions that combined self-monitoring with at least one other technique were significantly more effective than the other interventions in improving nutritional intake and increasing levels of physical activity (Michie et al, 2009). Social

Learning Theory is often used to promote skills and confidence with individuals who perform a particular activity, such as a cookery class or infant weaning where a new skill is taught (Heimendinger & Van Duyn, 1995). While basing interventions on these theories is optimal, they may not be cost effective for larger, long term interventions, as individual counselling may be required. The Pip Project was disadvantaged due to the man power – beneficiary ratio, so would not have been able to offer families intensive, personalised support. Up-skilling nursery and support staff in this methodology may be beneficial for future interventions.

10.2 A critique of the Pip study

In 2009 there were 742,300 people living in the 15% most income deprived areas in Scotland. Of these, 36% were income deprived, while in the rest of Scotland only 12% of the population is income deprived. This suggests that income deprivation is concentrated in certain areas. However, it also shows that not all people living in deprived areas are deprived and not all deprived people live in deprived areas. More income-deprived people live outside the 15% most income deprived areas than live in them (Scottish Government, 2009). It is therefore not possible to state that participating families from group 3 of the Pip study would be categorised as income deprived, or that the families whose children attended non-funded nurseries are not income deprived, without researching the family income and demographics, as placement in nursery is based on demographic ward, not income. Research into income and family situation at the initial stages of this research would have better determined the SES status of the participating families, regardless of their postal address. Future research should use standardised methods to determine socio-economic status of families, similar to those used by other national studies.

Initially, permission for participation in the study was required from the Head Teacher of each school (or Head of Nursery in situations where the nursery school was independent). According to Edinburgh Council Education Authority, 2002 was a year of low birth rate in Edinburgh, which led to low rates of enrolment in the year that parents were recruited to participate. Nursery participation was not compulsory, which means that the nurseries could not be selected at random. This self-selection process may have created a bias toward schools with an interest in health and healthy eating. Only 32 out of 105 nurseries in Edinburgh agreed to participate, which reduced the potential sample size significantly.

Once agreement was given, all parents who had a child aged 3 starting at nursery in August 2005 were contacted through open days and by nursery. There was no incentive to participate and participation was not compulsory; therefore parents were also recruited using a method of ‘self-selection’. This creates a bias as parents who have more of an interest in health and healthy eating will be more likely to participate than parents who do not; however due to ethical considerations together with the timeframe in which the data was to be collected, voluntary involvement was the only possible method of recruitment.

The Pip Project was designed to impact on the diet of those from the most socially excluded families, working in the nurseries that were demographically situated to capture children from the lowest SES status. Annually, 2,000 children benefitted from the Pip Project. This population who participated in this research may not have been representative of the Pip project beneficiaries. Different research methodologies may have enabled greater participation from a more representative sample, and with a different study design, other benefits of the project may have been identified.

Although the methodology used allowed the researcher to collect more comprehensive data, compared to retrospective methods the five-day diet diary supplied was considered by the participants to be very time consuming, and single parent families or parents who have other children (and particularly younger children), or parents who work may not have been able to dedicate the time required to complete the diet diary. Parents with social issues such as drug and alcohol misuse, domestic violence and abuse, and families with mental health issues where levels of trust in health professionals is low and there are lower rates of school involvement amongst parents, those who have learning difficulties, parents with low literacy and numeracy skills or a low level of education and parents with English as a second language may have struggled with providing the information required. This may have reduced the number of participants who were able to participate, and may also have led to a skewed population sample and an inaccurate picture of what people, and particularly of those in areas of low socio-economic status, are consuming. All data was gathered in spring and summer, which may also give skewed data due to seasonal variations and food availability. As such, in retrospect the pilot study could have been better used to discuss alternative methods of data collection with parents and adapted the study design accordingly. Diaries are less appropriate where literacy levels are low (Bowling 2002, cited in Wiseman, 2005). Data such variety and volume of fruit and vegetables consumed over the five day period could have been collected using other methodologies such as an FFQ or 24 hour recall.

The researcher encountered a range of difficulties when entering the data into the WinDiets program:

1. It was difficult to understand the handwriting of some of the participants

2. The information provided was adhered to in varying degrees by the parents in the study. Some parents entered more than sufficient information such as ml of fluid consumed, whereas other participants were vague with the food items consumed, i.e. they would not specify a portion size or amount of a particular food item consumed The researchers' interpretation of what the parents had written down may therefore have been incorrect

3. Occasionally whole meal information was excluded, for example a child from a broken home went to stay with the father, and the mother wrote *'I do not know what my child had for dinner'*. On these occasions the meal was left out but this was taken into account in the analysis of the data; for example only 4 days of the diet were analysed and an average was taken.

4. On other occasions, for example if the child went to a birthday party, the parent would write '*my child has a selection of the following…*' On these occasions a small sample of each of the foods listed was entered if possible, otherwise the meal was left out but this was taken into account in the analysis of the data; for example only 4 days of the diet were analysed and an average was taken.

5. Often parents would note 'bread' without specifying type or size. In this instance, white bread, average, medium slice was selected. Parents would also write 'jam' or chocolate spread, without noting the amount. In these instances, the portions given on the WinDiets programme were cross-referenced with 'Food Portion Sizes' (Mills et al, 2002) to estimate intake.

6. Some items on WinDiets are conflicting, i.e. there are 'semi-sweet biscuits' and 'semisweet biscuits' both listed, which have different levels of saturated fats and sugars per item. Within the WinDiets program there was also great variation in the fat content of different cuts of the same meat. In these instances further research was carried out to determine which listed food item was the most accurate.

7. Many of the parents used brand names that were not recognised by WinDiets, for example the database contains Kellogg's cereal products but does not contain Nestle. This was also an issue when entering carbonated and soft drinks, for example the

only diet carbonated drink was coca cola. In these instances the food item that was most similar to the item recorded in the diary was used for the diet analysis. This means that the information entered into the individuals' diet diary is not completely accurate.

8. There was limited data on brands available in WinDiets at the time of the research, which may have impacted both the energy breakdown and the micronutrient data.

Due to the complexity and the longevity of the research there was a significant drop out rate, which led to a reduced sample size at all stages of the intervention; therefore the absolute control group was merged with group 2, who received some resources and activities. This means that there was no absolute control for this intervention. As research was not carried out to determine which aspects of the Pip study were most affective, it is not possible to confirm which aspect of the intervention led to dietary change in each group. Although data was collected out with the nursery to determine dietary impact in the home, it would have been beneficial to collect data within the nursery setting to see what children within the nursery are eating, and to compare the parents understanding of child preferences to actual consumption.

As discussed in Chapter 3, all methods of dietary assessment have an element of bias and misreporting. Although dietary records that require detailed data entry over a number of days are considered more comprehensive than food recalls and food frequency questionnaires, there is some evidence to suggest that individuals, and particularly obese individuals or individuals who perceive their diet as poor, will inaccurately report food consumption (see section 3.4.3) Were the study to be repeated, a different methodology would be selected. For research such as this, where the desired target audience are from the most socially excluded populations, a methodology such as the USDA five step multi-pass method may have been more appropriate, which could include pictorial assistance and supported collection of data to encourage participation from these parents (United States Department of Agriculture, 2015). Using a 24-hour recall methodology may have reduced the respondent burden, and may have also encouraged parents with less literacy skills to participate. However, single 24-hour recall is not considered to be representative of habitual diet at an individual level (Medical Research Council, 2015). Four repeat 24-hour recalls were recommended as the most appropriate method of dietary assessment for data collection in the Low Income Diet and Nutrition Survey (Holmes et al, 2008). Telephone and face-to-face interviews may be a useful dietary recall method, although data entry may be time consuming. Research by the EPIC study has shown no significant difference in results between the five-step multi-pass recall method when applied face to face, by telephonic interview or electronically collected (Brustad et al, 2003). In a validation study (Reilly et al., 2001) of 41 pre-school children aged 3 to 4 years (23 boys, 18 girls) recall interviews with parents were used to assess diet over 3 consecutive days (two weekdays, one weekend) using both face to face and telephone interviews. For the first recall interview (face to face) the average time taken was 15 to 20 minutes. For the second and third recall interview (telephone) the average time taken was less than 10 minutes. Portion sizes were estimated from household measures and published food portions. This method was found to be quick for investigators and well tolerated by respondents. However, the group estimate of energy intake was significantly (11%) greater than energy expenditure. With modern technology, and the common use of smart phones and applications, gathering of dietary research could be made less costly and less time consuming for both the participant who needs to record the data, and the researcher who needs to enter it, and may offer a more engaging and accurate method of gathering data using a multiple pass 24 hour recall method than traditional paper based methods, particularly for children and young adults (Albar et al, 2016; Bradley et al, 2016; Carter et al, 2016). Methods for diet diary recording could include websites and smart phone applications such as the recently developed myfood24 online 24 hour dietary assessment tool and smartphone application (My Meal Mate) that complements the FCDB food composition database and contains more than 40,000 generic and branded food and drink items as opposed to the currently limited UK food composition tables that contain approximately 3,300 generic food and drink items (Carter et al, 2016); mobile phones with cameras to easily document and send researchers pictures foods before and after eating (Caspersen et al, 2015; Hongu et al, 2015; Weiss et al, 2010). Some of these tools may eventually be suitable for young children also.

10.2.1 Further limitations of this research

From the initial study design it was decided that no monetary or food based incentives could be given throughout the study period, as any incentive offered, particularly one of monetary value, may have led to inaccurate reporting or falsification as it was deemed essential that participants wanted to complete the diet diary accurately and in detail. However research indicates that incentives do not affect the reported intake and that underreporting still occurs even when incentives are offered (Hendrickson & Mattes, 2007). In addition, there was no available funding to provide an incentive to participating families. With only one researcher, it was difficult to dedicate adequate time to all interested families to assist them with completion of the questionnaire and to fully explain the requirements of the diet diary. It is possible that the high dropout rate was linked to a) parents signing up to the study without fully realising what was expected of them, and b) parents feeling unsupported when completing the diet diary. Children were not able to self-report so parents were asked to report on their behalf. Likes and dislikes were therefore biased by parents' perception. To more accurately identify fruit and vegetable preferences, research should take place within the nursery setting and on a one to one basis with each child; however, this would be time consuming. Blood levels of nutrients were not taken as part of this research, which may have been beneficial to identify changes in biochemical markers for iron and other nutrients. Because of the sample size, which significantly reduced over the research period, there were not enough participants to clearly show statistically significant differences between the intervention groups over time. To successfully carry out data of this kind a larger sample size is required. Previous studies of a similar nature have had varying rates of response. The initial response to the Payne & Belton study was 33% to the letter of invitation, which was anticipated by the researchers given the intense nature of the study (Payne and Belton, 1992). This once again highlights the issue of obtaining dietary information from families with young children, and especially those from complex home environments.

10.3 Suggestions for further research

1. Subjective studies to better understand dietary intake and lifestyle barriers of the socially excluded are required: using research methodology which is not intimidating and allows the participant to provide data regardless of reduced language, literacy or numeracy skills may give researchers a better understanding of diet in the most deprived areas.

2. Researchers should determine the most effective methods of changing the balance of the diet within the home; research is required to determine the direct effect of parental food preferences on the diet of children, and whether interventions that directly target parental dietary intake has a positive impact on the family diet over time.

3. Research is required to determine whether consumption of additional fruit displaces the NME sugar food items such as soft drinks, confectionery and cakes, or whether the fruit eaten is consumed in addition to these items, therefore increasing the total sugar intake, and energy intake, subsequently contributing to the obesity epidemic.

4. Research is required to determine whether interventions that promote the consumption of additional fruit are negatively impacting on the balance of the diet as a whole, and whether additional fruit displaces meals that contain more wholesome food items rich in protein, iron, and other nutrients, therefore negatively effecting on the overall protein and micronutrient intake of the diet.

5. Researchers require a better understanding of the impact that fortified foods and supplements could have, particularly in sub-populations where intakes of certain nutrients are lower than the RNI.

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12 Appendices

Appendix 1: Letters and forms for permission:

a. Letter from CEC Education department

·EDINBVRGH·
THE CITY OF EDINBURGH COUNCIL

EDUCATION
QUALITY SERVICES

Kirstie Lawton
Edinburgh Community Food Initiative
22 Tennant Street
Edinburgh
EH6 5ND

Date 23 November 2004

Your ref

Our ref Q/krb/rr677

Direct dial 0131 469 3164

Dear Ms Lawton

THE EFFECT OF THE PIP PROJECT ON PRE-5 CHILDREN AND THEIR FAMILIES

I am writing in response to your recent telephone call and e-mail requesting permission to undertake research in schools in The City of Edinburgh. I maintain a database of research requests made to the Education Department and have been asked to reply to your letter.

Your request has been considered and I am pleased to inform you that you have permission **in principle** to undertake your research.

I must stress to you that it is the policy of the Education Department to leave the final decision over participation in research requests of this kind to Head Teachers and their staff. This letter does not oblige schools to take part in your research and you should make this clear to the Head Teacher when you make your initial approach. You will be aware that schools operate under considerable pressures and the Education Department is always reluctant to increase these demands further. Therefore, I would ask you to keep your request to a minimum.

I would like to wish you every success with your project and look forward to receiving a copy of your completed findings in due course.

Yours sincerely

Ken Bogle

Dr Ken Bogle
Resources and Research Officer

Wellington Court 10 Waterloo Place Edinburgh EH1 3EG Tel 0131 200 2000 Fax 0131 469 3141

INVESTOR IN PEOPLE

b. Approval by QMU ethics committee

Copy for Kirstie.

Queen Margaret University College

EDINBURGH

Linda Welsh
Registry Officer
Queen Margaret University College
Clerwood Terrace
Edinburgh EH12 8TS

Tel: 0131 317 3219
Email: lwelsh@qmuc.ac.uk

Kirstie Lawton
Supervised Research Student
Dietetics, Nutrition and Biological Sciences
School of Health Sciences

19 May 2005

Dear Kirstie

Request for Ethical Approval for a Research Project – Evaluating the effect of the Pip project on pre-school children and their families within lower socio-economic groups in Edinburgh

The Research Ethics Committee considered your application for ethical approval for the above research project at its meeting on 20 April 2005, and I am pleased to inform you that it has granted ethical approval in principle. The Committee however requires that the following points be addressed before full approval is granted:

- Applicant to submit her draft questionnaire, since there is a need to clarify what is being asked of the subjects.
- 'Letter to Parents' - amend paragraph 4, sentence 3, to read "….all information you *or your child* give will be confidential and your name*s* will not be used."
- Make clearer to parents the nature of the 'fruit games' mentioned in the letter, including who might be leading the games. It might be useful to include a statement for the parents outlining how they might explain to their children what is involved in these games.
- Consent Forms for Head Teacher and for Parents – remove the reference in the title of the project to "lower socio-economic groups".

You should submit the revised information sheet and consent form along with your written response to the points above.

Please send your response to the Committee's requirements directly to me.

Yours sincerely,

Linda Welsh

Linda Welsh
Secretary to the Research Ethics Committee

Cc Michael Clapham, Director of Studies

Campuses at Corstorphine, Edinburgh EH12 8TS | Leith, Edinburgh EH6 8HF | Gateway Theatre, Edinburgh EH7 4AH
Telephone +44(0)131 317 3000 Fax +44(0)131 317 3256 www.qmuc.ac.uk

THE QUEEN'S ANNIVERSARY PRIZES
2002

c. Nursery letter to request permission

Queen Margaret University College
EDINBURGH

Supported by
BIG LOTTERY FUND

PiP

3 December 2004

Dear Head Teacher

As you are aware, the Pip Project is a pre-5 Healthy Eating Initiative that aims to increase the amount of fruit consumed by children in disadvantaged areas across the city. Your nursery is one of 43 that receive free fruit on a weekly basis.

As part of the project I am undertaking a PhD that will look at the impact that the project has on children and their families over a 2-year period from June 2005 to June 2007. During this time, the families will be asked to complete diet diaries in order to assess their overall diet quality. They will also be asked to participate in interviews relating to barriers to healthy eating.

I am writing to request your permission to recruit families whose children will be joining your nursery in August 2005. Should you give your permission, an information sheet and consent form will be distributed to all incoming parents.

Each parent who agrees to participate will be given full details about the project and their involvement. There will be no obligation for families to participate and all families that do agree to participate will reserve the right to withdraw from the study at any time throughout the 2 years.

If you would like to give permission for me to recruit parents from your nursery, please sign and return the enclosed sheet. If you have any questions please contact me by email klawton@ecfi.org.uk or by telephone, 0131 467 7326.

Thank you for your time

Kirstie Lawton
Development Worker, Pip Project

d. Nursery consent form

Queen Margaret University College
EDINBURGH

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"Evaluating the effect of the Pip Project on pre-school children and their families within lower socio-economic groups in Edinburgh"

Name of Head Teacher: ______________________________________

Name of Nursery: ____

Date: _______________________

I hereby give permission for Kirstie Lawton, Development Worker for the Pip Project and research student at Queen Margaret University College, to approach parents of children attending the above-mentioned nursery for participation in a research project, to commence in July 2005.

Signature of Head Teacher: _____________________________________

Signature of Researcher: _______________________________________

Contact details of researcher:

Kirstie Lawton
Edinburgh Community Food Initiative
22 Tennant Street
Edinburgh
EH6 5ND
Email: klawton@ecfi.org.uk

e. Parent letter

Queen Margaret University College
EDINBURGH

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PiP

Dear Parents

Your child is about to start nursery. This means that they will now receive free fruit for snack through the 'Pip Project'.

The Pip Project is a pre-5 healthy eating project funded by the Big Lottery Fund that encourages children to eat a greater amount and wider variety of fruit and vegetables.

My name is Kirstie Lawton. I work for the Pip Project and am also a part time postgraduate student at Queen Margaret University College. This means that I will be spending the next 2 years working closely with selected families across the city to try and find out which of the activities used in the project help people to eat a healthier diet.

I am looking for 60 families to take part in this project. To take part you should have at least one child starting at nursery in August 2005. If you agree to take part, you will be asked to keep a record of everything that you eat and drink for five days once every eight months (you will be given a 'diet diary' to note this down) as well as a questionnaire to fill in – this will ask you about things that you think prevent people from eating more healthy foods. From time to time you may be asked about your views on healthy eating.

This study will run for 2 years. You will be free to withdraw from the study at any time and would not have to give a reason. Results from this study may be made public, however all information you or your child give will be confidential and your name will not be used.

If you would like to contact an someone who knows about this project but is not involved in it for advice or information, please call Ian Shankland, Manager, Edinburgh Community Food Initiative on 0131 467 7326.

If you have read and understood this information sheet and would like to participate in this study, please sign the consent form enclosed and hand it in to the head of nursery, or mail it to me in the stamped addressed envelope enclosed.

Thank you for your time

Kirstie Lawton
Edinburgh Community Food Initiative

edinburgh community food initiative

f. Parent consent form

Queen Margaret University College

EDINBURGH

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"Evaluating the effect of the Pip Project on pre-school children and their families in Edinburgh"

I have read and understood the information sheet and this consent form.

I have had the opportunity to ask questions about the study and what is expected from me over the course of the 2 years.

I understand that I am under no obligation to take part in this study.

I understand that I have the right to withdraw from this study at any stage without giving any reason.

I agree to participate in this study.

Name of participant: ________________________

Signature of participant: ________________________

Nursery ____

Signature of researcher: ________________________

Date: ________________________

Contact details of researcher:

Kirstie Lawton
Edinburgh Community Food Initiative
22 Tennant Street
Edinburgh
EH6 5ND
Tel: 0131 467 7326
Email: klawton@ecfi.org.uk

edinburgh community food initiative

Appendix 2: List of participating nurseries[61]

Nursery name	FSM (%)	Av FSM (%)	Ward (Apr 2005)	Ward score
Abbeyhill	33%	24%	Holyrood	10
Balgreen	No data	22%	Stenhouse	14
Brunstane	33%	17%	Milton	22
Calderglen	No data	40%	Murrayburn	4
Carrick Knowe	9%	5%	S.E Corstorphine	40
Castleview	75%	67%	Craigmillar	1
Children's House	No data	67%	Craigmillar	1
Cowgate Under 5's	No data	37%	Holyrood	10
Craigour park	39%	27%	Inch/Gilmerton	16
Dalry	52%	49%	Dalry	15
Drumbrae	18%	10%	N.E Corstorphine	38
Ferryhill	31%	34%	Drylaw	2
Flora Stevenson	7%	16%	Dean	57
Fort	66%	34%	Newhaven	13
Fort 2	66%	34%	Newhaven	13
Juniper Green	6%	42%	Baberton	46
Leith	36%	22%	Leith Links	23
Liberton	No data	34%	Alnwickhill	28
Murrayburn	21%	40%	Sighthill	17
Parsons Green	7%	10%	Holyrood	10
Pirniehall	59%	53%	Pilton	5
Royal Mile	51%	37%	Holyrood	10
Sighthill	55%	40%	Sighthill	17
St Joseph's	40%	47%	Sighthill	17
St Marys Leith	14%	25%	Lorne	12
St Ninian's	33%	23%	Restalrig	3
Stanwell	No data	41%	Harbour	11
The Royal High	16%	17%	Mountcastle	24
The Spinney Lane	No data	38%	Gilmerton	16
Towerbank	16%	10%	Portobello	29

[61] This table shows the different identifying factors for inclusion of nurseries into the Pip Project: Ward Score = a score assigned to every ward in the City of Edinburgh, based on 2003 Scottish Indices of Multiple Deprivation (SIMD) data, where 1 is most deprived ward in Edinburgh and 46 is the least deprived ward; % FSM is the 20033 City of Edinburgh Council Free School Meal (FSM) percentage; Average Free School Meal (Av. FSM) % is the mean geographical FSM % (closest 3 schools). This was used a) because some nurseries were not affiliated to a primary school and b) to identify regional pockets of deprivation and affluence.

Tynecastle	No data	35%	Shandon	34
Westburn	45%	40%	Murrayburn	4

Appendix 3: Questionnaire

PIP STUDY QUESTIONNAIRE

1. Where do you mostly shop for your FRUIT? (PLEASE TICK ONE BOX ONLY)
Please include TINNED, FRESH, FROZEN and DRIED

1.1	Supermarket e.g. ASDA, Tesco, Sainsbury's, Safeway	[
1.2	Food store e.g. LIDL, Iceland, Kwik Save, ScotMid	[
1.3	Local shop e.g. corner shop / Newsagents	[
1.4	Local community food co-op	[
1.5	Other ________________________________	[

2. Where do you mostly shop for your VEGETABLES? (PLEASE TICK ONE BOX ONLY). Please include TINNED, SALAD STUFF, FRESH and FROZEN

2.1	Supermarket e.g. ASDA, Tesco, Sainsbury's, Safeway	[
2.2	Food store e.g. LIDL, Iceland, Kwik Save, ScotMid	[
2.3	Local shop e.g. corner shop / Newsagents	[
2.4	Local community food co-op	[
2.5	Other ________________________________	[

3. On average, how much do you spend on FRUIT every week? £__________
(PLEASE INCLUDE TINNED, FRESH, FROZEN AND DRIED)

(It might be an idea to attach weekly shopping receipts if you are unsure)

4. On average, how much do you spend on VEGETABLES every week? £__________
(PLEASE INCLUDE TINNED, SALAD STUFF, FRESH AND FROZEN)

(It might be an idea to attach weekly shopping receipts if you are unsure)

5. Which of the following do you normally buy?

(PLEASE CIRCLE ALL ANSWERS THAT APPLY)

Fresh fruit 5.1 Tinned fruit 5.2 Frozen fruit 5.3 Dried fruit 5.4

Fresh Juice 5.5 Salad stuff 5.6 Fresh vegetables 5.7

Tinned vegetables 5.8 Frozen vegetables 5.9 Vegetable soup 5.10

6. How do you feel about the following statements? (PLEASE SCORE EACH STATEMENT FROM 1 TO 5 WITH 1 MEANING **STRONGLY DISAGREE** AND 5 MEANING **STRONGLY AGREE**)

	Strongly disagree ←			→ strongly agree	
6.1 "Fruit cost too much"	1	2	3	4	5
6.2 "Vegetables cost too much"	1	2	3	4	5
6.3 "Fruit takes too much time to prepare (peeling etc.)	1	2	3	4	5
6.4 "Vegetables take too much time to prepare"	1	2	3	4	5
6.5 "Fruit goes off too quickly and money is wasted"	1	2	3	4	5
6.6 "Vegetables go off too quickly and money is wasted"	1	2	3	4	5
6.7 "Children prefer other snacks such as crisps/sweets"	1	2	3	4	5
6.8 "There is a good choice of fruit in local shops"	1	2	3	4	5
6.9 "There is a good choice of vegetables in local shops"	1	2	3	4	5
6.10 "The quality of fruit in local shops is good"	1	2	3	4	5
6.11 "The quality of vegetables in local shops good"	1	2	3	4	5
6.12 "It can be difficult to cook fruit and make it tasty"	1	2	3	4	5
6.13"It can be difficult to cook vegetables and make them tasty"	1	2	3	4	5

7. How much do **you** like the following **fruits** and **vegetables**? (PLEASE SCORE EACH FRUIT OR VEGETABLE FROM 1 TO 5 WITH 1 MEANING **REALLY DISLIKE** AND 5 MEANING **REALLY LIKE**. IF YOU HAVEN'T TASTED THE FRUIT OR VEGETABLE LEAVE THE LINE BLANK)

	Really dislike ←			→ Really like	
7.1 Pear	1	2	3	4	5

7.2 Apple	1	2	3	4	5
7.3 Banana	1	2	3	4	5
7.4 Melon	1	2	3	4	5
7.5 Kiwi	1	2	3	4	5
7.6 Pineapple	1	2	3	4	5
7.7 Strawberry	1	2	3	4	5
7.8 Orange	1	2	3	4	5
7.9 Satsuma	1	2	3	4	5
7.10 Grape	1	2	3	4	5
7.11 Mango	1	2	3	4	5
7.12 Plum	1	2	3	4	5
7.13 Nectarine	1	2	3	4	5
7.14 Peach	1	2	3	4	5
7.15 Cucumber	1	2	3	4	5
7.16 Tomato	1	2	3	4	5
7.17 Carrot	1	2	3	4	5
7.18 Bell peppers	1	2	3	4	5
7.19 Broccoli	1	2	3	4	5
7.20 Cauliflower	1	2	3	4	5

8. How much does your child like the following **fruits** and **vegetables**? (PLEASE SCORE EACH FRUIT OR VEGETABLE FROM 1 TO 5 WITH **1** MEANING **REALLY DISLIKE** AND **5** MEANING **REALLY LIKE**. IF YOU HAVEN'T TASTED THE FRUIT OR VEGETABLE LEAVE THE LINE BLANK)

Really dislike ⟵⟶ Really like

8.1 Pear	1	2	3	4	5
8.2 Apple	1	2	3	4	5
8.3 Banana	1	2	3	4	5

8.4 Melon	1	2	3	4	5
8.5 Kiwi	1	2	3	4	5
8.6 Pineapple	1	2	3	4	5
8.7 Strawberry	1	2	3	4	5
8.8 Orange	1	2	3	4	5
8.9 Satsuma	1	2	3	4	5
8.10 Grape	1	2	3	4	5
8.11 Mango	1	2	3	4	5
8.12 Plum	1	2	3	4	5
8.13 Nectarine	1	2	3	4	5
8.14 Peach	1	2	3	4	5
8.15 Cucumber	1	2	3	4	5
8.16 Tomato	1	2	3	4	5
8.17 Carrot	1	2	3	4	5
8.18 Bell peppers	1	2	3	4	5
8.19 Broccoli	1	2	3	4	5
8.20 Cauliflower	1	2	3	4	5

The government recommend that you eat 5 portions of fruit and vegetables every day.

9. Were you aware of this? 9.1 Yes 9.2 No 9.3 Unsure

10. What do you think of this recommended amount?
(PLEASE CIRCLE ONE ANSWER ONLY)

10.1 Way too much

10.2 A bit too much

10.3 Just right

10.4 Not enough

10.5 Far too little

11. Which of the following do you think of as 'a portion' of a fruit or a vegetable?
(PLEASE CIRCLE AS MANY AS YOU THINK ARE APPROPRIATE)

11.1 1 melon

11.2 1 glass fresh orange juice

11.3 1 cherry tomato

11.4 ½ a bell pepper

11.5 ½ a banana

11.6 1 apple

11.7 1 punnet strawberries

11.8 3 broccoli spears

11.9 ½ a pineapple

11.10 4 dried apricots

12. How often do you do the following?
(PLEASE CIRCLE ONE ANSWER ONLY FOR EACH QUESTION)

Regularly – at least once a day

Occasionally – at a few times a week

Rarely – no more than once a week

12.1 Regularly Occasionally Rarely Never

PLEASE GIVE EXAMPLES

12.2 Make soup Regularly Occasionally Rarely Never

PLEASE GIVE EXAMPLES

12.3 Use a recipe book Regularly Occasionally Rarely Never

PLEASE GIVE EXAMPLES

12.4 Cook a meal using your own recipe Regularly Occasionally Rarely Never

PLEASE GIVE EXAMPLES

12.5 Experiment with new fruits Regularly Occasionally Rarely Never

PLEASE GIVE EXAMPLES

12.6 Experiment with new vegetables Regularly Occasionally Rarely Never

PLEASE GIVE EXAMPLES

Your child:

13. Age ____________

14. Gender 14.1 M / 14.2 F

15. Ethnic background ________________________________

16.Previous schools / nurseries / childcare facilities attended

____

12.1.1.1.1 Thank you for your time

Appendix 4: Sample diet diary

Dear Parent,

Thank you for taking the time to complete this diet diary. Once your diary is complete, please place it in the envelope provided and either hand it to your nursery teacher or pop it in the mail. Once your diary has been returned your name will be removed from the front cover so that the information you give is anonymous.

Please read through the following instructions carefully before you start and contact me on 0131 467 7326 or by email, klawton@ecfi.org.uk if you have any questions.

Filling in your food diary

1. Please write down EVERYTHING that you and your child EAT and DRINK over 5 days.

2. Please eat what you would EAT NORMALLY so that the information you provide is as normal as possible. Remember that nobody is judging you and all information given is anonymous.

3. Start the diary on a Wednesday, Thursday, Friday or Saturday so that you include a weekend in your diary. Do not start on a Sunday, Monday or Tuesday.

4. When writing down what you eat, try to DESCRIBE THE FOOD – there are some photos of portion sizes at the back of this document. Use them to describe what you have eaten:

    - ❖ If you have eaten a portion the same size as the one in the photo write 'M' for 'medium' in the portion sizes column (or write 1 portion)
    - ❖ If you have eaten a portion half the size of the one in the photo, write 'S' for 'small' in the portion sizes column (or write ½ a portion)
    - ❖ If you have eaten a portion 1 ½ times the size of the photo, write 'L' for 'large' in the portion sizes column (or write 1 ½ portions)
    - ❖ If you have eaten a portion twice the size of the photo, write 'XL' for 'extra-large' in the portion sizes column (or write 2 portions)
    - ❖ OR you can use measurements such as 'teaspoon', 'tablespoon', 'cup', 'handful', '½ can', 'thick slice', 330ml can, 'regular bag' (i.e. crisps).

5. Make a note of the brand of the product, i.e. 'Findus' fish fingers, 'Kingsmill' bread, 'McCain' oven chips, 'Stork' margarine, 'Coca' cola or 'Pepsi' cola, 'Ribena'

6. Try to describe each food item as accurately as possible. Here are some examples:

❖When making a note of bread say if it is brown, multigrain, white, thick, thin etc.

❖When making a note of spreads say if they are regular, light, extra light etc.

❖If using cheese say what kind. Is it cheddar, mild etc.

❖When making a note of juice say if it is from concentrate, no sugar added etc.

7. Make a note if the meal is homemade and try to write down all of the ingredients and their quantities. Even better, put a copy of the recipe in the diet diary.

8. Make a note of how the food is cooked, for example fried, grilled, roasted or baked.

9. Try to separate anything you eat into the individual items used. For example, if you have a cheese sandwich break it down like this:

- 2 slices thick white bread
- 1 teaspoon flora spread
- 2 tablespoons grated cheddar cheese
- ½ a tomato
- 2 teaspoons salad cream

10. If you eat away from home, try to describe what you had i.e. 'big mac and fries', 'sausage supper with 2 king size pork sausages'

11. Your child may be at nursery either morning or afternoon or in some cases all day. The staff members at the nursery are aware that you are taking part in this research and have been given forms to record what your child has eaten for snack on the days that you are keeping a record. Ask the staff at the nursery to keep a record for you on the sheet provided and put this information in with the diet diary before you send it in.

12. At the end of the day think back – have you remembered to write down everything that you ate and drank?

13. DON'T FORGET TO MENTION EVERYTHING THAT YOU & YOUR CHILD DRINK! This should include milk and sugar that you have in tea or coffee, all drinks including alcoholic, water, fresh or diluting juice and any other hot drinks you might have.

Completing a diet diary

Here is a sample diet diary to give you an idea of the sort of information you should provide. Remember to record portion sizes, cooking method, brands etc. Use the photos in the back of this diary to help you with your portion sizes.

Day: Monday Date: 18th June

	What you ate	**What your child ate**
8.00	2 thin slices asda own brown bread (toasted)	1 medium bowl cheerios
	1 teaspoon butter	Whole milk (grahams dairy)
	2 teaspoons robertsons raspberry jam	Tesco own orange juice from concentrate,
	2 cups tea with 2 teaspoons sugar and	Medium glass
	whole milk	1 small cup tea (half whole milk half tea with
		2 sugars
1.00	2 slices thin brown bread (asda own)	1 slice thin brown bread (asda own) with 1
	4 tablespoons toasted cheddar cheese	Tablespoon toasted cheddar cheese
	1 regular bag walkers crisps (ready salted)	1 regular bag walkers crisps (cheese and onion)
	1 can diet coke	1 can irn bru
3.00	1 cup tea with whole milk and 2 teaspoon sugar	½ packet strawberry chewitts
		1 carton ribena

6.00	3 slices goodfella's margarita deep pan pizza	3 Findus fish fingers, grilled, small can Heinz beans
	(pizza sliced into 6 pieces)	1 tablespoon Heinz tomato ketchup
	2 handfuls tesco own pre bagged Italian salad	Small handful McCains oven chips
	1 330ml can budweiser	1 small glass diluting Robinson's blackcurrant
		(no sugar added)
7.30	1 330ml can budweiser	1 glass whole milk, medium
		1 chocolate hobnob

Note that all drinks, including fizzy drinks, soft drinks, juices and alcoholic drinks have been recorded. It is also important to make a note of any sweets, crisps, biscuits, cakes or ANY TYPE of snack that is eaten by you or your child throughout the day.

The foods that the child receives in nursery will be recorded on a different piece of paper. Let your nursery staff know what day to start recording your child's snacks and drinks. At the end of the 5 days ask the nursery staff for this sheet of paper and simply slot it in to your completed diet diary before you return it.